Technology Review

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ALSO IN THIS ISSUE:

- *Nicholas Negroponte on Truly Personal Computers*
- *Electricity Without Global Warming*
- *John Dingell and the Importance of Being Skeptical*
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JANUARY 1992

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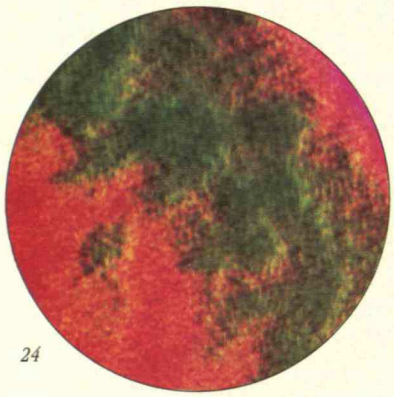

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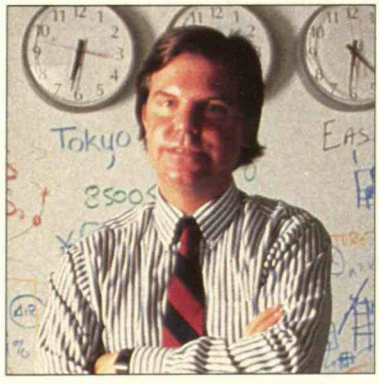

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COVER:

After long and successful use of the vaccinia virus as a vaccine against smallpox, researchers are trying to use it as a vehicle to carry genes in more sophisticated vaccines. *Photograph by James Callagan/CNRI/Phototake. Design by Kathleen Sayre.*

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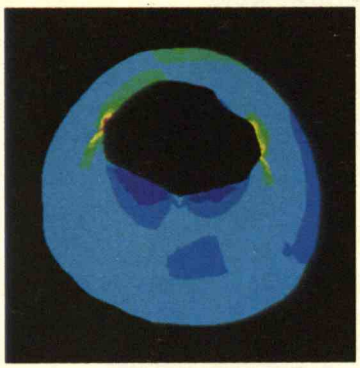

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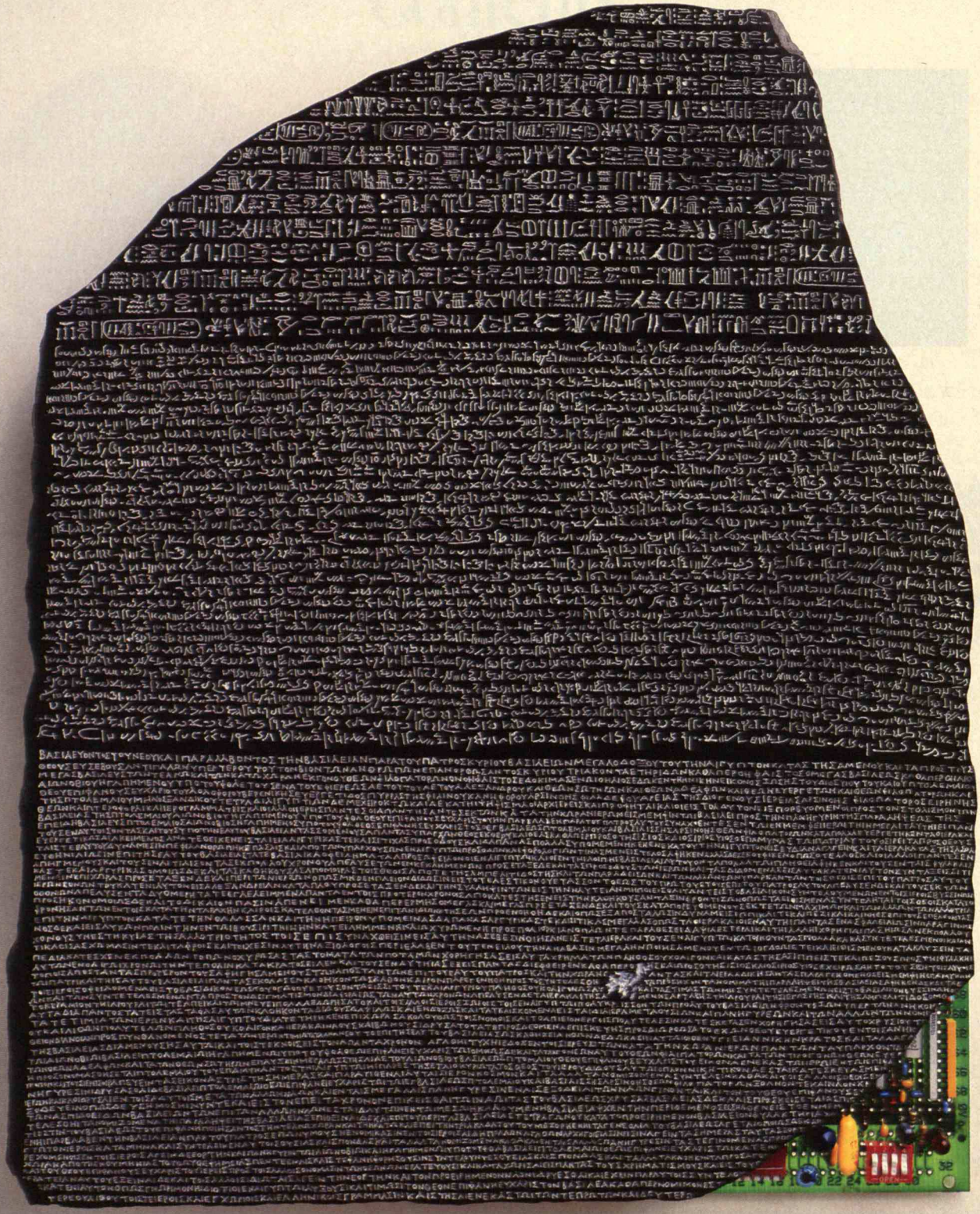

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First Line

A Public Agenda

In 1964, at the height of the Cold War, a diverse group of scientists, journalists, and activists sent a document entitled "The Triple Revolution" to President Johnson. The signatories pointed to three social and technological changes then underway that would fundamentally alter the United States and the world community.

The first two changes would be positive. The group predicted that continued advances in the sophistication of weapons of mass destruction would discredit war as a means of resolving conflict. And the group anticipated a universal demand for human rights then manifested in the gathering momentum of the U.S. civil rights movement.

But the third change would have more ominous effects. The group foresaw the coming of a "cybernation revolution" in which sophisticated computers would deprive growing numbers of people of their livelihood. As computers eliminated jobs, the group feared the creation of a "human slag heap of tens of millions of Americans that do not have the skills to participate in a computerized society." The signatories urged the president to appoint a commission to study the impact of technological change in general, and of computers in particular, on U.S. society.

A generation later this document seems remarkably prescient. But the primary recommendation of the "Triple Revolution" signatories has not been fulfilled: the United States still has no explicit mechanism for planning the goals and anticipating the results of technological change. Yet the group's observation that "gaining control of our future requires the conscious formation of the society we wish to have" remains an urgent need.

That goal is now more likely to be fulfilled because of stunning progress on the group's first two "revolutions." The end of the Cold War has created an unprecedented opportunity for the United States to move beyond a military-dominated agenda for science and technology. And growing public participation in matters both political and scientific has prompted more and more citizens to demand the right to influence the nation's technological agenda.

But should the public have a broader role in deciding how U.S. society should deal with complex issues such as global warming? In an article in this issue ("Electricity Sources Without Carbon Dioxide"), David C. White, Clinton J. Andrews, and Nancy W. Stauffer of the MIT Energy Lab lay out a strategy—a diverse slate of technological options—

You don't have to be an expert to make sound technological choices.

that humanity could pursue in moving away from carbon-based fuels. Recent popular involvement with technologies from nuclear power to trash incineration has shown that such options will be accepted only if they enjoy broad public support.

Although many technologists may dread such involvement, a companion piece—"You Don't Have to Be a Rocket Scientist," by John Doble and Amy Richardson of the Public Agenda Foundation—suggests that the public may be more savvy than generally believed, and in fact think very much like scientists, in making technological choices. As all five authors make clear, access to good information is the key to responsible public participation.

In October 1991 another group met at the Institute for Policy Studies in Washington to consider mechanisms for public involvement in a "needs-based" national science and technology agenda as envisioned by the Triple Revolution signatories. The conference addressed many different problems, but a unifying theme was that an explicitly public blueprint for technology would require designers of products and techniques to consider potentially adverse effects—as well as socially desirable goals—from the start.

Toward this end, Rustum Roy, professor of solid state physics at Penn State, recommended rethinking the U.S. premise that massive government funding of basic science will automatically foster technologies of economic and social benefit. Why not reverse the priorities and, for example, unleash the talents of technologists—research at the national labs included—in a Manhattan Project to prevent global warming?

Gary Chapman of Computer Professionals for Social Responsibility called on the United States to pursue a strategy that uses technology to enhance workers' contributions rather than minimize them— "systems for experts rather than expert systems." In that spirit, he proposed a program modeled on the highly successful agricultural extension service that would funnel advice and information to citizens and communities trying to decide on and influence their technological options. John Cavanagh, a fellow at the Institute for Policy Studies, would have the U.S. establish minimum environmental and workplace standards—a community "bill of rights"—to free local leaders from having to compete for companies by compromising the health of their constituents. Such initiatives could serve as models for other countries and even as criteria for completing trade agreements.

Government would also have a role to play in establishing economic incentives that point industry in enlightened directions, and in making technological literacy an integral part of moves to revitalize public education.

As recipients of public research funds, technologists have a special responsibility to encourage and contribute to such innovative thinking. The public needs them to join with its representatives to establish the contours of a national science agenda that incorporates pragmatic and participatory new ideas.

SANDRA HACKMAN

Letters

Energy from Nuclear Explosions

In "A Practical Route to Fusion Power" (*TR July 1991*), Abraham Szöke and Ralph W. Moir argue that peaceful nuclear explosions (PNEs) in underground chambers can now provide a practical source of power. They propose creating a cavity, lining it with bolted steel, setting off hydrogen bombs every 20 minutes, transferring the generated heat, preferably with molten lithium beryllium fluoride, and then recycling nuclear materials. Upon first glancing through the article, I wondered whether the authors were toying with idle speculation or science fiction.

Consider the effect of heating steel to high temperatures: well before melting, it loses its strength and becomes chemically reactive. So much for the viability of the steel container. And once the container is breached, the surrounding rock would react to form fluorides, which would melt or vaporize and likely cause the underground cavity to collapse.

Then think of the effect of high temperatures on lithium beryllium fluoride: it would vaporize and be a highly reactive witches' brew charged with radioactive materials. Remember, too, that beryllium is a lethal poison and is dangerous even to mine and produce. A worse choice of a compound to accompany a fusion bomb could hardly be imagined.

The Department of Energy has conducted various underground tests with "controlled" burns of deeply buried coal deposits (the Hanna and Hoe Creek experiments in Wyoming), and these have failed because uncontrolled heating and fusion of surrounding rock have made the system collapse. The idea that underground hydrogen bombs could be more easily harnessed than a simple chemical reaction seems highly unreasonable.

ERIC ESSENE
Professor of Geology
University of Michigan

The large underground cavity Szöke and Moir propose could obviously be replaced by a molten-salt fission reactor vessel, and a controlled, continuous fission reaction could be carried out in lieu of the repetitive explosions they call for. Moreover, fission reactors can be breeders, so resource conservation would not be an issue. This type of system is far more of a proven concept than the infernal contraption sketched in the article. Nevertheless, widespread acceptance of the technology has not been forthcoming.

It's worth noting as well that a cavity of the type the authors would use eventually becomes a high-level waste repository—one that would not be licensable under current Nuclear Regulatory Commission specifications. In fact, if it were licensable, this would mean that one could just dump spent fuel from today's commercial reactors into a conventional or explosively mined cavity—a concept rejected by review panels worldwide over the past three decades.

In brief, I can see no excuse for entertaining serious consideration of PNE other than to provide a cover for weapons-lab scientists working on neutron bombs.

MICHAEL J. DRISCOLL
Emeritus Professor
of Nuclear Engineering, MIT

In the early days of nuclear power research, PNE would have been called a "two-rock project," for it merges nuclear-explosives technology with molten-salt technology. In the two-rock concept, if Rock A cannot float and Rock B cannot float, then tie them together and somehow they will float.

PNE is an engineering nightmare. The authors provide typical handwaving arguments to justify their case, confident that few persons are aware of the historic classified research showing the serious problems ahead. Not the least of these is the difficulty of circulating corrosive molten salts. Also, the reprocessing of uranium-233 from molten salts was studied in detail in the 1960s and was shown to be extremely hazardous.

Moreover, the annual cost that the authors propose would merely be the tip of the iceberg. Once the engineering problems were carefully defined, the cost would escalate by a factor of ten. And the time required to prove feasibility would be a superb guarantee of job security for a very large staff of engineers and scientists.

Finally, even if the PNE project had engineering merit, it would never succeed for a simple political reason: no state wants to be the home of a nuclear-waste repository, and no state would permit construction of a PNE facility within its borders. Further, the Nuclear Regulatory Commission would certainly not issue an operating license for such a facility.

In the mid-1960s, I chaired the Plutonium Research Coordinating Committee, a group tasked to protect classified research information. We once met at the Lawrence Livermore National Laboratory and received a detailed briefing on thermonuclear weapons development. I found the descriptions of weapons research frightening. It was exactly like a scene from *Dr. Strangelove.* I had the same feeling while reading about PNE, for it is a classic example of the weaponeers' mentality at work. With luck, the scheme will go no further than the pages of *Technology Review.*

WILLIAM L. R. RICE
Fairfax, Va.

The writer was technical assistant to the director of the U.S. Fusion Energy Program from 1972 to 1974.

The authors respond:

Contrary to what Prof. Essene suggests, the hot fireball from a PNE would be extinguished in a fraction of a second, during which time the steel would hardly have time to heat up. The chamber would be kept cool by a thin layer of liquid, just as sweat keeps the body cool in a sauna, and during the 20-minute wait until the next explosion, the molten salt would reach only about 600 °C, a temperature at which it is known to be non-corrosive.

Moreover, steel-reinforced underground cavities are now so well made

that cracks would be rare. And any time a crack did occur, the molten salt with its radioactive contents would simply be drained to storage tanks while repairs were being made.

In answer to Prof. Driscoll, the inventory of molten salt with its residual dissolved fission fuels and wastes would be transported to another place for processing, use, and disposal when a power station of our design was decommissioned. It remains for further analyses to show whether the fission wastes that cannot be cleaned off would constitute high-level wastes.

Finally, despite the fears of Mr. Rice, molten salt can be contained in stainless steel with minimal corrosion, and pyrochemical processing appears both practical and economical. Remote handling and robotics would be used to deal with the hazards of reprocessing. And as for the cost, only a detailed technical and engineering study could determine that.

ALL WORK AND NO PLAY . . .

Although my main concern is the ability to use leisure, not the lack of leisure (see the forthcoming edition of my book *The Joyless Economy*), I welcome Juliet Schor's article and recommendations (*"Workers of the World, Unwind," TR November/December 1991*). However, management need not take all the blame for the lack of leisure in U.S. society. Western Europeans have much more leisure than we do not because their capitalists are less interested in profit or less good at making it, but because people in those countries want more leisure and are more skilled in its enjoyment. Without enough skills for enjoying leisure, it becomes boring; and boredom leads to consumerism in the affluent, decline and premature death in the aged, and violence and drugs in the unemployed young.

Prof. Schor seems to believe that once people have leisure, they can be trusted to acquire the skills to use it. There is some truth to that, but not much. People who have had ample leisure for

generations do develop skills to enjoy it, which their children learn at their mother's knee. Witness the rich folk art of Europe's feudal peasantry, who exercised artistic leisure skills during the long winters when they had no work to do.

But with industrialization, those skills atrophied, so schools must now take the place of mothers' knees. And though schools used to mainly teach leisure skills, that lasted only as long as education was the privilege of a leisure class. Now that education is free and universal, teaching work skills and inculcating work discipline have been added, and these have become the schools' main function in our country with its Puritan ethic. Moreover, schools have tried to keep up with the increasing demand for work skills, which has meant that liberal arts—in other words, leisure skills—have been gradually crowded out.

To get more leisure, the public must want it more, which calls for putting more emphasis on teaching leisure skills. Even enough literacy to enable people to read for pleasure is in shockingly short supply. One-third of U.S. adults are estimated to be functionally or marginally illiterate, and according to the President's Commission on Education, "The vast majority of American adults are unable to interpret the main argument from a lengthy newspaper column."

TIBOR SCITOVSKY
Emeritus Professor of Economics
Stanford University

Continued on page 79

MIT Reporter

Heart Attacks and Plaque Mechanics

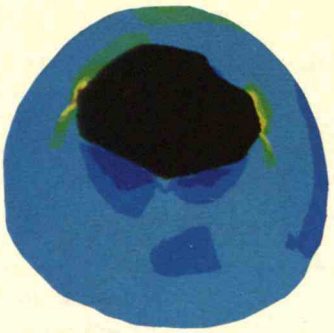
The single most lethal disaster in American life is the rupture of a lump of plaque in a coronary artery. The body responds by making blood clots that can block the artery and cause a heart attack. Some 500,000 people in the United States are killed this way annually.

But not all plaques—fatty deposits that usually result from elevated cholesterol, high blood pressure, or smoking—are equally dangerous. If doctors were able to distinguish risky plaques from the stable ones that don't lead to heart attacks, they could concentrate on treating the bad ones and perhaps save lives.

At a mechanical engineering laboratory at MIT, researchers are trying to figure out the differences among plaques. Using a computer model to simulate the stresses that the deposits ordinarily encounter, the investigators are showing how the shape and composition of plaques affect their vulnerability. Richard Lee, a cardiologist at Brigham and Women's Hospital in Boston, Roger Kamm, a mechanical engineering professor, and Alan Grodzinsky, a professor of electrical engineering and computer science, are working on the project.

The work grows from the realization that heart attacks do not occur randomly across any given day. In 1985, cardiologist James Muller of Boston's New England Deaconess Hospital made the chance discovery that people are stricken most often in the morning—that the risk of dying from a heart attack is twice as high in the first two hours after getting up than it is for the rest of the day.

When researchers began to ask why the heart is most vulnerable during this period, they learned that the body is then a mine field of dangers. Waking up releases a burst of stress hormones such as adrenalin. So does standing up, thinking about work, and fighting traffic to the workplace. The hormones, in turn, make the heart beat faster, the blood pressure rise, and the arteries narrow. These changes put physical stress on plaques, raising the risk that they will break.



This computerized "stress map" shows the cross-section of a coronary artery, indicating in orange and yellow the areas where plaque— which covers much of the artery's bottom half— is most likely to rupture, starting a process that can lead to a heart attack.

The blood clots that the body makes to repair broken plaques tend to be bigger in the morning, when blood platelets are stickier. (Nobody knows why platelets are stickier in morning, although researchers suspect that there once might have been an evolutionary advantage.) This increases the chance of a clot filling a coronary artery and choking off the supply of oxygen to the heart. Yet most plaques never break, and many people with chronic heart disease live to ripe ages. The question becomes which plaques won't hold up.

Finding Unstable Plaques

The standard tools of cardiology provide few clues about how plaques differ. Doctors routinely diagnose heart problems with angiograms, x-ray images that show outlines of coronary plaques but reveal little about their stability.

"It's becoming quite clear that some lesions that appear mild and benign on coronary angiography are actually unstable and very worrisome when looked at structurally," says Lee.

To get to the bottom of the problem, the team removed coronary arteries from cadavers. They traced the shape of the vessels, and they noted in the observed plaques the location of lipids, calcium, and other materials that affect plaque vulnerability to breakup. Then with a mechanical testing machine, investigators imposed small amounts of stress on the plaques to see what kind of strains resulted.

Finally, they entered all the information into a computer model that subjects the simulated artery to stresses like those resulting from the normal fluctuations in blood pressure. The program, run on a Cray supercomputer, produced color maps depicting the levels of stress across each artery. With this simulation, the researchers began to predict which plaques were likely to break.

Now the team has started to validate its predictions by comparing them with arteries removed from about 50 people who died from heart attacks. The researchers will see if the plaques identified by the computer as most dangerous are the ones that actually broke. If the predictions are correct, they should be useful in developing rules for sorting plaques based on their shape and composition.

Only then will doctors be able to apply the findings—and the researchers expect that day to be several years away. The biggest obstacle to practical use could be the imaging techniques available for patients today. Cardiologists can send tiny ultrasound scanners via catheters—specialized tubes—into the arteries to produce cross-sectional pictures of the vessels, but the images are too fuzzy to accurately indicate what plaques are made of.

Once doctors have at their disposal ultrasound scanners that can make more detailed images, however, Lee believes his group's way of looking at heart disease will guide cardiologists in using therapies. For instance, intentionally breaking dangerous plaques might make sense. By squishing them with angioplasty balloons while administer-

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ing clot-inhibiting drugs, doctors may be able to neutralize the plaques before they kill. *—Daniel Q. Haney (The author is a science reporter for the Associated Press.)*

PLAYING TENNIS IN THE DARK

Most people like to watch tennis games in sunlight. Rudrapatna Ramnath, however, uses a darkened lab when he holds matches between a tennis racket and a ball machine. As cameras record the scene, only a flickering strobe light illuminates the balls' movements.

Ramnath, a passionate tennis player and MIT adjunct professor of aeronautics and astronautics, conducts what Jim Baugh, general manager of racket sports for Wilson Sporting Goods, believes are the only independent tests of tennis racket quality performed by an engineer in the United States. For the past 12 years *World Tennis* magazine has published monthly Ramnath's results for those tennis players who don't want to buy rackets based only on claims of superiority by their manufacturers or by professional players who have promotional contracts.

Ramnath measures four key factors that he says help define quality. He determines rackets' power by deducing from the strobe-light pictures how fast a ball flies before and after it hits the strings. From the ratio of these velocities, Ramnath finds the place on the face of the racket that imparts the most power—the so-called "sweet spot" where the hardest strikes can be made.

Another important factor is the racket's stiffness. "The stiffer a racket, the faster the ball will move when you hit it," he explains. Racket makers have greatly improved stiffness in the past decade by widening frames and using new materials. "The result is that women today can speed the ball in a way only men could in the earlier days," Ramnath points out.

To measure stiffness, he fixes the racket in a horizontal position, loads the center of its face with three different weights, and evaluates how the frame bends with each weight.

By showing how fast a tennis ball moves before (top) and after a stroke, strobe lighting can help in determining a racket's power and "sweet spot."

Ramnath also checks for the amount of "vibration damping," which relates to the feelings players have in their hands and arms after hitting balls. Too little damping can result in physical ailments such as tennis elbow. After fixing the frame horizontally, Ramnath attaches to the racket's surface light piezoelectric sensors, which send voltage information to an oscilloscope. By dropping round weights onto the center of the racket, Ramnath can check how fast the vibration slows down, and hence, the damping level.

And by applying a quick series of forces to the side of the racket's hitting area, Ramnath can measure oscillations with the sensors and calculate the racket's "resistance to twist"—its stability when a player hits a ball laterally off center.

But the tests alone can't determine how a particular racket will feel to a player. Therefore, Ramnath has also served as one of six test players for World Tennis, giving subjective marks for the same factors he tests in the lab. Over the years, it's proven to be a good excuse to play with the more than 1,000 rackets he has tested. *—Monika Weiner (The author is a Knight Science Journalism fellow at MIT.)*

COMPUTERIZED SEARCHES FOR CANCER CELLS

Bob Harvey's wife, a nurse, threw down the gauntlet: if you Lincoln Laboratory researchers are smart enough to devise technologies to defend the country, why can't you do something about a "real world" threat like cervical cancer?

Her comment appealed to the problem solver in Harvey. Each year, according to the American Cancer Society, up to 5,000 women in the United States die of cervical cancer, even though all could have been cured had the disease been caught early. Human error and too few

technicians studying millions of Pap smear slides—each contains at least tens of thousands of cervical cells—mean that too many cells in the first stages of cancer go undetected.

Harvey, a specialist in image processing and neural networks, took up his wife's challenge two years ago. The result of his work, conducted at Lincoln Labs under a Department of Defense grant for innovative research, is a machine vision system that detects cancerous cells of the cervix, according to early test results. In initial testing, the machine judged 50 cells, including both normal and diseased ones, with 100 percent accuracy, according to Harvey.

Harvey and two assistants in his opto-radar systems group, Karl Heinemann and technician Mary Fouster, "trained" a neural network—a computer system that with experience can grow increasingly better at recognizing objects or certain information—by showing it 150 example cells and indicating whether these were normal or abnormal.

After first breaking an image into basic screen elements (pixels), Harvey's system uses an "edge detector" to move in spiral fashion from outside the picture in and analyze the edges of the shapes defined by contiguous pixels. Humans also make sense of images by focusing first on edges, according to Harvey. In his system, a neural net "classifier" then compares the information—again, he says, like our brains would do—to what the machine has seen before.

Today, the system consists almost entirely of software that runs on a workstation and mini-supercomputer. The next stage of development will be to increase the system's speed by transferring more software tasks to hardware. Meanwhile, using actual laboratory slides pathologists expect to begin field-testing the system at the Lahey Clinic, a research and treatment hospital in Burlington, Mass., in early 1992.

Having applied for a patent, the researchers would eventually like to market the system to hospital laboratories. If they do, they won't be alone: hospitals and labs are already testing a handful of inventions aimed at solving the "false negative" problem with Pap smears. For example, Neuromedical Services Corp. of Suffern, N.Y., has developed a neural network system to pick out the 64 most suspect cells of the 50,000 to 300,000 cells in a typical smear.

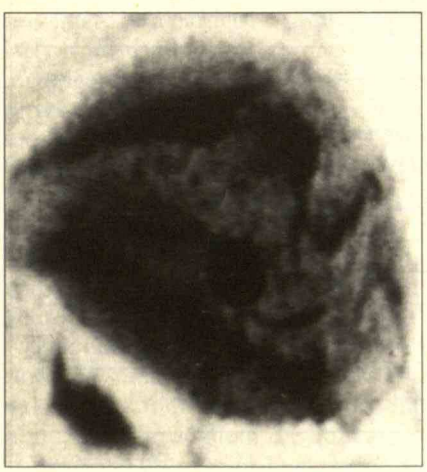
Martha Hutchinson, director of cytopathology at the New England Medical Center in Boston, sees the competition as positive. "I hope we see the best of all these things in 10 years," she says. But she adds that any system that tries to totally automate the screening process and not leave room for human interpretation "goes against the grain" of traditional medical thinking.

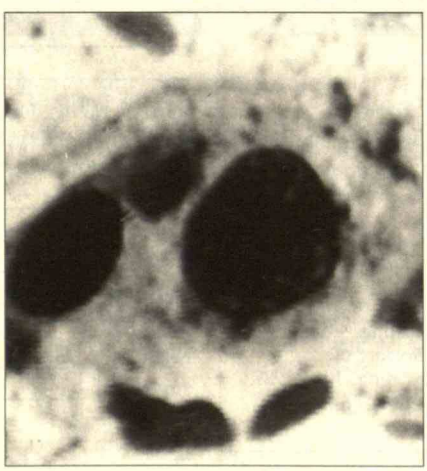
Toward that end, Harvey says he does not think his system should replace pathologists' examinations of Pap smears. It should serve only as another opinion, to ensure that doctors haven't missed anything on cell slides.

Harvey and his assistants are also keen on using the system for other applications. "Its applications could go far beyond Pap smears, which are probably the simplest problem in pathology," to looking for many kinds of abnormal cells, says Mark Silverman, Lahey's chair of pathology. And Harvey foresees uses in areas such as military systems and quality-control scanning in manufacturing. In addition to classifying cells, he says, the system has distinguished among military tanks, howitzers, and armored personnel carriers seen at various angles.

Some machine-vision and artificial-intelligence experts are skeptical about the breadth of possible uses, however. Tomasso Poggio, MIT Uncas and Helen Whitaker Professor of Brain and Cognitive Sciences, says that neural networks just haven't advanced beyond single specific uses. "If a system could be trained to identify different objects" under various conditions, Poggio says, "and do that reliably—I'd be very surprised." He explains that this would be a big jump from the simple classifying systems that are currently used.

Harvey thinks that field-testing will reveal his system's strength. "What separates the sheep from the goats," he says, "is how the thing performs in the real world."—*Lisa Watts*





A machine vision system developed at Lincoln Laboratory has, during initial testing, distinguished normal from abnormal cervical cells. One difference relates to the cells' nuclei: a small round nucleus lies in the center of a normal cell on the left, while an abnormal cell on the right has a larger, irregularly shaped nucleus (center of photograph.)

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Trends

Venomous Pursuit

Scientists have long known that spiders are potent predators. After scouring a plot of land near his home in Sussex in 1939, for instance, the British entomologist W.S. Bristowe astounded his colleagues by calculating that every year spiders in Britain consumed a quantity of insects that far outweighed the island's human population.

Today many neuroscientists are training their microscopes on the complex properties of the poison that spiders and other venomous creatures use to kill their prey. Natural toxins not only offer clues to the brain's functioning but also hold the promise of suggesting novel drug therapies.

The chemical content of spider venom is proving to be a particularly fruitful subject of investigation. In the early 1980s, a team of researchers in Japan discovered the mechanism by which a joro spider paralyzes its prey. Experimenting with the nerve cells of squid, the scientists showed that spider venom acted very precisely to block the effects of glutamate, an amino acid that is an important neurotransmitter.

The discovery drew special interest since the same neurotransmitter is critical to the functioning of the human brain. Cells throughout the human nervous system use glutamate as one of several chemicals that allow electrical signals to pass from one cell to another. Recognized by receptors in the cells, glutamate can act like a key in a lock, causing the cell wall to open a channel to the flow of ions.

Natural toxins, like the venom from this Lynx spider, are yielding new insights into brain chemistry and could help treat ailments such as strokes and Alzheimer's disease.

As researchers quickly realized, a venom that could effectively block the effects of glutamate might lead to a variety of human therapies. That's because unlike many other neurotransmitters, too much glutamate can kill a nerve cell—a phenomenon called excito-toxicity.

For instance, excessive glutamate activity is linked to much of the damage from certain acute traumas. In a stroke, a blood clot starves brain cells of oxygen and nutrients. The system responds by producing too much glutamate. In the excito-toxic reaction that ensues, a frantic chain of biochemical signals often kills nerve cells far from the site of the stroke. Some researchers think that a drug derived from spider venom could inhibit this devastating effect.

Excessive glutamate activity has been linked to nerve-cell death not only in acute traumas like strokes but also in chronic degenerative disorders like Alzheimer's disease. One kind of glutamate receptor—the NMDA receptor—is the subject of intense interest because it may play a role in learning and memory.

Pharming for Pharmaceuticals

Even the Pentagon is taking a keen interest in natural toxins. The Army's Biological Defense Research Program is interested in the possibility that snake venom genes, and possibly others as well, might lead to biological warfare agents.

One reason for such disparate research into venoms is that many mech-

PHOTO: THOMAS EISNER

anisms involved in normal neurological functioning are poorly understood. In the burgeoning field of neurobiology, scientists have previously lacked ways, for instance, to differentiate among types of receptors and pathways.

By contrast, natural toxins like spider venom can offer phenomenally precise chemical probes, highly specific in the way they work on victims. As Robert McBurney, a vice-president at Cambridge Neuroscience Research, puts it, "People will always try to synthesize neat-looking chemical structures, but biological organisms have evolved to do their jobs extremely well—they get it right."

Because natural toxins from spiders, snails, and snakes attack specific neurochemical targets, some researchers use them to identify specific ion channels. For example, Baldonero Olivera, a biochemist at the University of Utah, has already used toxins that come from snails to identify a wide diversity of calcium-ion channels, each playing a role in slightly different aspects of brain activity.

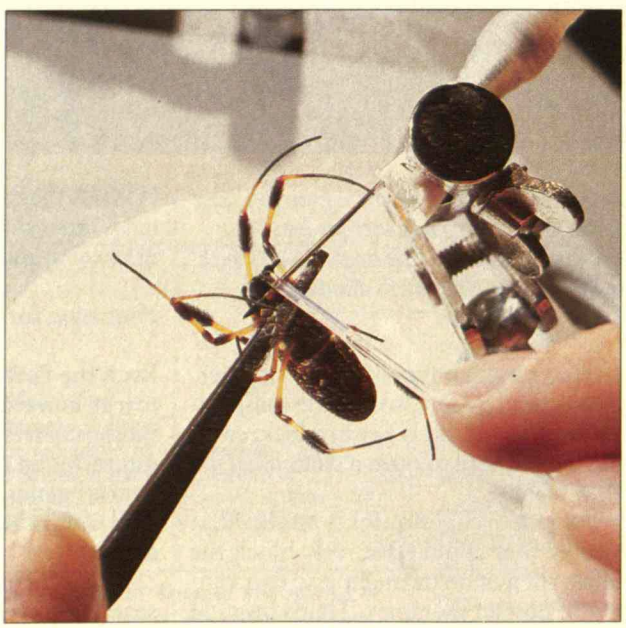
Based in Massachusetts, Cambridge Neuroscience is betting on the potential of spider venom as a source of drug therapies—so-called neuroprotective compounds. Since 1985, the biotech startup has worked on two classes of venom-derived drugs: one that blocks the effects of glutamate and another that works further along the nerve system to block the passage of charged calcium ions through channels in nerve cells.

McBurney says his firm's spider research, funded in part by the National Institutes of Health, follows in a rich tradition of pharmaceutical investigations into the therapeutic properties of natural poisons such as curare and digitalis. Similarly, Natural Product Sciences in Salt Lake City is pursuing diverse products based on naturally occurring toxins from spiders, snakes, scorpions, and other animals. The company receives funding from the large pharmaceutical firm Pfizer, which has its eye not only on developing drugs related to strokes and degenerative neurological diseases but also on synthesizing chemicals from natural toxins to create drugs for relieving anxiety and depression.

The breadth of research has even spawned a sub-industry: spider catchers. Consider Spider Pharm, based in Black Canyon City, Ariz. The firm milks the venom from its collection of a dozen varieties of spiders and sells it to investigators around the world.

—SETH SHULMAN

Several firms, including Utah-based Natural Product Sciences (NSP), "milk" spider venom for use in research. Below, NSP's arachnid collection.



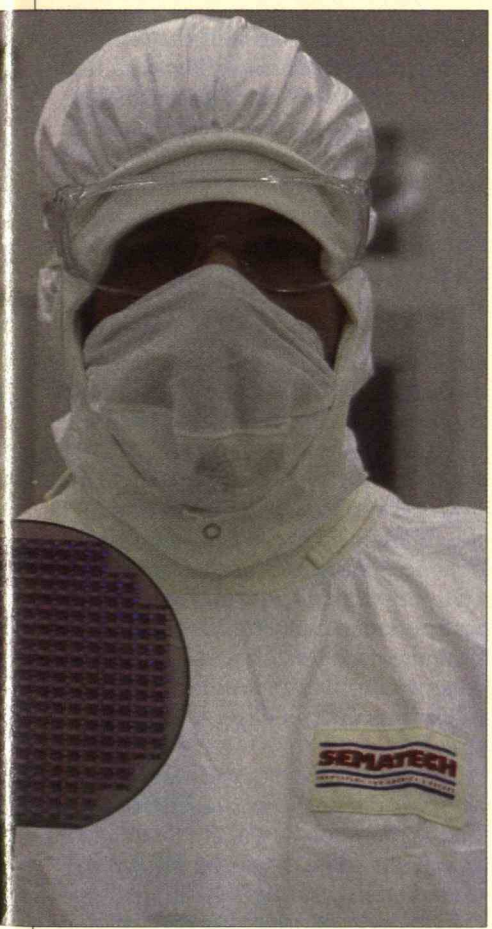
A Model—But What Kind?

For almost five years, a government-industry collaboration has taken tentative steps toward a U.S. technology strategy of sorts. Based in Austin, Tex., Sematech (for Semiconductor Manufacturing Technology) brings together 14 U.S. chip makers. They account for 80 percent of the nation's semiconductors and include the Pentagon's top seven suppliers of integrated circuits.

The government's immediate interest in semiconductor manufacturing stems from national-security considerations. A 1987 Defense Science Board report noted a growing U.S. dependence on foreign sources for state-of-the-art weapons components and called this a threat to U.S. security. Congress agreed, so the Department of Defense now provides $100 million dollars of Sematech's annual funding, with member companies putting up the balance of the $225 million budget. But although the federal contribution depends on congressional oversight and approval, industry sets Sematech's goals, strategies, and timetables. The emphasis has been on improving the manufacturing process through designing better tools and developing new processes and techniques.

The consortium's goal is to help the United States regain world leadership in microchip manufacturing by 1993, and its supporters hail Sematech as a model for future government-industry partnerships. However, not everyone is satisfied with the collaboration. The Campaign for Responsible Technology (CRT), a network of environmental, labor, and community groups, such as the Silicon Valley Toxics Coalition, Computer Professionals for Social Responsibility, and

PHOTOS: NATURAL PRODUCT SCIENCES



A worker at Sematech's Austin-based manufacturing plant displays a wafer of silicon computer chips. Some environmental, labor, and community groups maintain that a federally subsidized program like Sematech should include more citizen participation in its decision making.

sists that Sematech and other federally subsidized ventures need to broaden their goals. CRT seeks to promote local participation in technological decision-making, design, and production processes.

"We would like to see more initiatives like Sematech," says CRT national coordinator Rand Wilson, "but there should be some provision that industry isn't the sole beneficiary."

In a series of meetings and correspondence with Sematech officials, CRT has elaborated a list of concerns it believes should be added to Sematech's official mission. Among them are a commitment to reducing the use of toxic substances in chip making, pioneering new worker health and safety programs to reduce the rate of occupational illnesses in semiconductor plants, and training for people from disadvantaged communities so that they can work in these factories.

For example, Sematech is located in Montopolis, a predominantly Mexican- and African-American neighborhood in East Austin plagued by chronic unemployment and poverty. "The neighborhood is so poor that it doesn't even have a library," says CRT's Austin spokesperson Susana Almanza. Because Sematech receives local tax abatements and other incentives—for example, Sematech leases its site from the University of Texas for $1 a year— she says it ought to be responsible for assisting the local community economically.

Sematech officials maintain that the consortium already helps Montopolis and Austin, both directly and through a "ripple effect." The consortium's literature states that East Austin residents comprise 22 percent of Sematech's workforce and that East and South Austin businesses received $12.9 million through Sematech's purchase of goods and services. Moreover, Sematech contributed to the decision of 30 suppliers of semiconductor materials and equipment to relocate to Austin.

Quarterbacking for Industry

Almanza insists that such statistics are misleading. Workforce numbers are compiled by zip code, not neighborhood, she says. The East Austin zip code includes more affluent areas outside Montopolis. She contends that few people from Montopolis itself work for Sematech or its suppliers because most positions require advanced training and degrees. And she believes that Montopolis residents who work at Sematech are concentrated in the lowest-paid, least-skilled positions. Thus, CRT has called for job-training programs specifically targeted for Montopolis.

Toxic materials are another concern for CRT, since chip production uses and generates heavy metals, corrosive acids, explosive gases, and organic solvents that can endanger human health and the environment. Thus, says Wilson, Sematech should be involved in creating not just a smaller, faster chip, but a safer, cleaner way to make it. And he notes that Sematech's strategic position would make it easier to implement such innovations throughout the semiconductor industry.

A delegation from the Campaign for Responsible Technology (CRT) raises economic and environmental concerns at a meeting with Sematech managers in May 1991.

PHOTO: SEMATECH; COURTESY OF RAND WILSON

"Sematech is taking a leadership position in the industry to find safer, cleaner processes and equipment for the manufacture of semiconductors," responds Bill George, the consortium's chief operating officer. "Sematech transfers to its member companies technology that utilizes less toxic materials, reduces hazardous materials, and offers better environmental controls."

For example, Sematech's chemical reclamation program recycles about 97 percent of the acids used in chip making. The consortium's labs have also substituted solid arsenic for arsine gas, the most poisonous chemical used in semiconductor production. And Sematech is committed to reducing the use of Freon-113, an ozone-destroying chemical, as a cleaning agent.

Wilson acknowledges that Sematech has taken some positive steps, but thinks "they should be quarterbacking on occupational and environmental concerns in the same way that they are in other areas like manufacturing." He notes, for example, that Sematech could create a model safety and health training program for workers that member companies could adopt. Or it could help coordinate timetables and goals for eliminating toxic substances in manufacturing.

Overall, says Wilson, Sematech has addressed only a few of the issues that CRT and community groups have raised. In particular, it has yet to provide detailed information CRT has requested, such as a complete profile of the plant's workforce or the content of its health and safety programs.

Perhaps the most controversial item on the agenda is CRT's desire for more citizen participation in decisions about technological innovation. "There needs to be some sort of community, labor, or environmental participation" in the governance of government-backed consortia, says Wilson. "They have several different kinds of advisory boards and governing bodies within Sematech, but there's no voice for the kinds of concerns we're articulating. We need to have a seat at the table."—*TRACEY COHEN*

NEXRAD, the Next Generation Weather Radar, will help the National Weather Service predict and track tornadoes and violent thunderstorms. The project, now underway, is expected to include 160 installations like this one by 1997.

A Modern Weather Service

We blame forecasters when "partly cloudy" turns into an afternoon downpour, and blame them again when a promised cooling rain dissipates in the heat of a scorching drought. As meteorologist Peter Leavitt puts it, "Probably no one makes so many mistakes so publicly."

Now, however, the National Weather Service, part of the National Oceanographic and Atmospheric Administration (NOAA), is in the midst of a grand self-overhaul that could greatly improve the accuracy of predictions. Ironically, factors that—like the weather—are beyond a forecaster's control are impeding much of the effort.

More than a decade of planning has gone into the upgrade, which is long overdue in technological terms. "The system we're working with now is absolutely antiquated," says John Dutton, dean of earth and mineral sciences at Pennsylvania State University. Like Leavitt, an executive of a private weather-information firm, Dutton sits on the National Research Council's Committee on National Weather Service Modernization.

"The present system is designed to deal with weather systems and processes on the order of hundreds or even one thousand kilometers, and time scales on the order of six, twelve, or twenty-four hours," explains Dutton. This rough detail works for tracking fronts and cyclones. "However, the events that affect people most acutely are smaller-scale—severe thunderstorms, tornadoes, flash floods." To follow these phenomena, meteorologists need fresh data far more frequently and on much smaller scales.

No doubt the revitalization will achieve dramatic gains along these lines. The big question is, will the weather service get the new systems in place before the old ones collapse?

Consider the radars that now track violent storms. They are so old—most were built in 1957—that they rely on vacuum tubes. The systems fail frequently and can be out of commission for days, even weeks. Radars have been down when storms ripped through areas with disastrous consequences, prompting federal investigators in 1988, after tornadoes devastated parts of North Carolina where radar had been out of service for 10 days, to point to the "compelling, almost desperate, need to upgrade and replace the nation's aged system of weather radars."

The weather service also risks losing its eyes in the sky. Forecasters would like to have three Geostationary Operational Environment Satellites (GOES) in orbit at any one time, but a 1986 launch failure destroyed one and another went blind in 1989. The single GOES left will run out of fuel and drift out of orbit by 1993.

PHOTO: NATIONAL WEATHER SERVICE

Unfortunately, delays, cost overruns, and mismanagement have plagued replacement radars and satellites. For example, the Next Generation Weather Radar—NEXRAD—will help a forecaster peer inside developing storm clouds, better predict tornadoes and violent thunderstorms, and more precisely track their intensity and movement. The first NEXRAD, in tests last spring in Oklahoma, flawlessly tracked thunderstorms and developing tornadoes and enabled forecasters to issue warnings faster. When the system is complete, 160 NEXRAD installations will blanket the country.

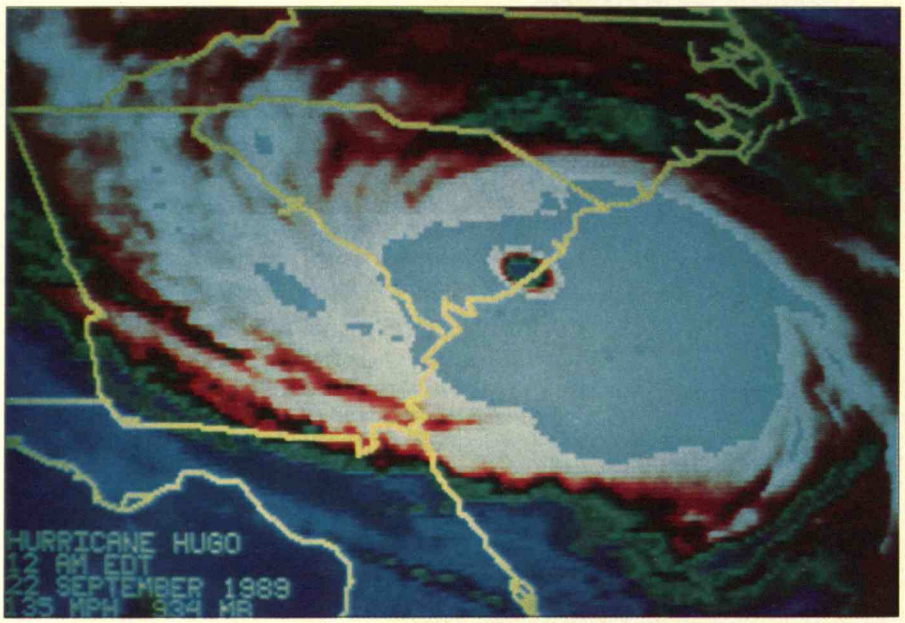
However, the project is two years behind schedule. In 1988, Unisys won the NEXRAD contract but later claimed it couldn't build the machines within budget. In August 1991, after heated discussion, Unisys and the government settled their argument, and NEXRAD is now expected to be fully ready in six years.

The Best That Money Can Buy

The story repeats itself with the newest satellites, GOES-NEXT. Besides providing more detailed weather data, GOES-NEXT will simultaneously record visual images and take soundings of temperature and moisture. (The present GOES can also do both but not at the same time.) And GOES-NEXT data will be higher quality and measured as often as every six minutes in severe weather.

Like NEXRAD, GOES-NEXT has a troubled history. NOAA gave NASA responsibility to run the program, and NASA selected contractors in 1985. But a General Accounting Office (GAO) report charges that nearly everything has gone wrong. The total cost has risen from $640 million to $1.7 billion because of cost overruns and technical problems. And because the program is now four years behind schedule, the United States may have no orbiting weather satellite if the last GOES fails soon.

To secure continuous weather surveillance, the United States has negotiated to



A new generation of satellite pictures—this one shows Hurricane Hugo, which devastated the eastern seaboard of the United States in the fall of 1989—can save lives, reduce injuries, and help protect property.

borrow a spare European satellite and move it into position over North America. Meanwhile, faulty instruments in the first GOES-NEXT will be replaced, and NASA hopes the satellite can be launched by early 1994.

While the GAO blames the contractors Ford Aerospace and ITT for poor work, it criticizes NASA and NOAA for underestimating the complexity of GOES-NEXT and poorly managing the program. According to the GAO, NASA has provided insufficient technical support, exercised little oversight, and failed to require the usual engineering studies and analyses. In congressional hearings, then-NASA associate administrator J.R. Thompson conceded that his agency and NOAA had "clearly misjudged the difficulty of this program from the outset."

The modernization—and the snags—go further. The Automatic Surface Observation System will record ground conditions such as temperature, wind, and humidity at over 1,000 sites. The weather service has already installed some 300 automatic thermometers, but those in the Southwest have read too hot by as much as two degrees. The weather service is modifying the design before installing more.

The Advanced Weather Interactive Processing System, the computer network that will tie all this together, is another eagerly awaited upgrade. Beefing up NWS computers—including supercomputers—is a longstanding concern. "The weather service has had to scrimp and scrape to try to get adequate computing power," notes Penn State's Dutton. "We could buy the world's finest computers for the National Security Agency but not for the weather service—until just recently."

Despite the mass of problems, Charles Hosler, Jr., chair of the NRC's modernization committee, is still optimistic about the revamping. "This is going to be a real quantum leap in weather prediction that will save lives, reduce injuries, and help protect property."

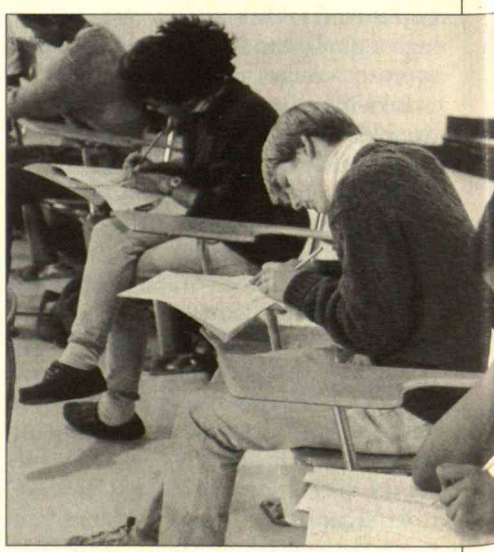
Nevertheless, Hosler and his colleagues worry that the whole effort lacks enough resources—budget, management, and technical—to accomplish its objectives. "Parsimony now will be expensive later," says Hosler. "Because most of the parts of the system are interdependent, they all have to be done right."—*DAVID BJERKLIE*

Workplace SATs

In April 1991, President Bush announced *America 2000*, a strategy for encouraging excellence in education. Along with voluntary national achievement tests for fourth, eighth, and twelfth graders, *America 2000* calls for "job-skill standards." If the White House prevails over objections that this concept could discriminate against women and minorities, scholastic aptitude tests (SATs) may no longer be reserved for college-bound students. Similar exams may find wider use as job criteria for even entry-level positions.

"A major reason for establishing tests and urging colleges and employers to take them into account," explains Chester Finn, Jr., professor of education and public policy at Vanderbilt University, "is to change the behavior of elementary and secondary school students so that they learn much more in school." As consultant to the Department of Education, Finn was one of the architects of *America 2000*. He says that "for most youngsters, there's little tangible reward

Standardized tests, modeled after the Scholastic Aptitude Tests used in the college admissions process, may soon be adopted for use in job placement.



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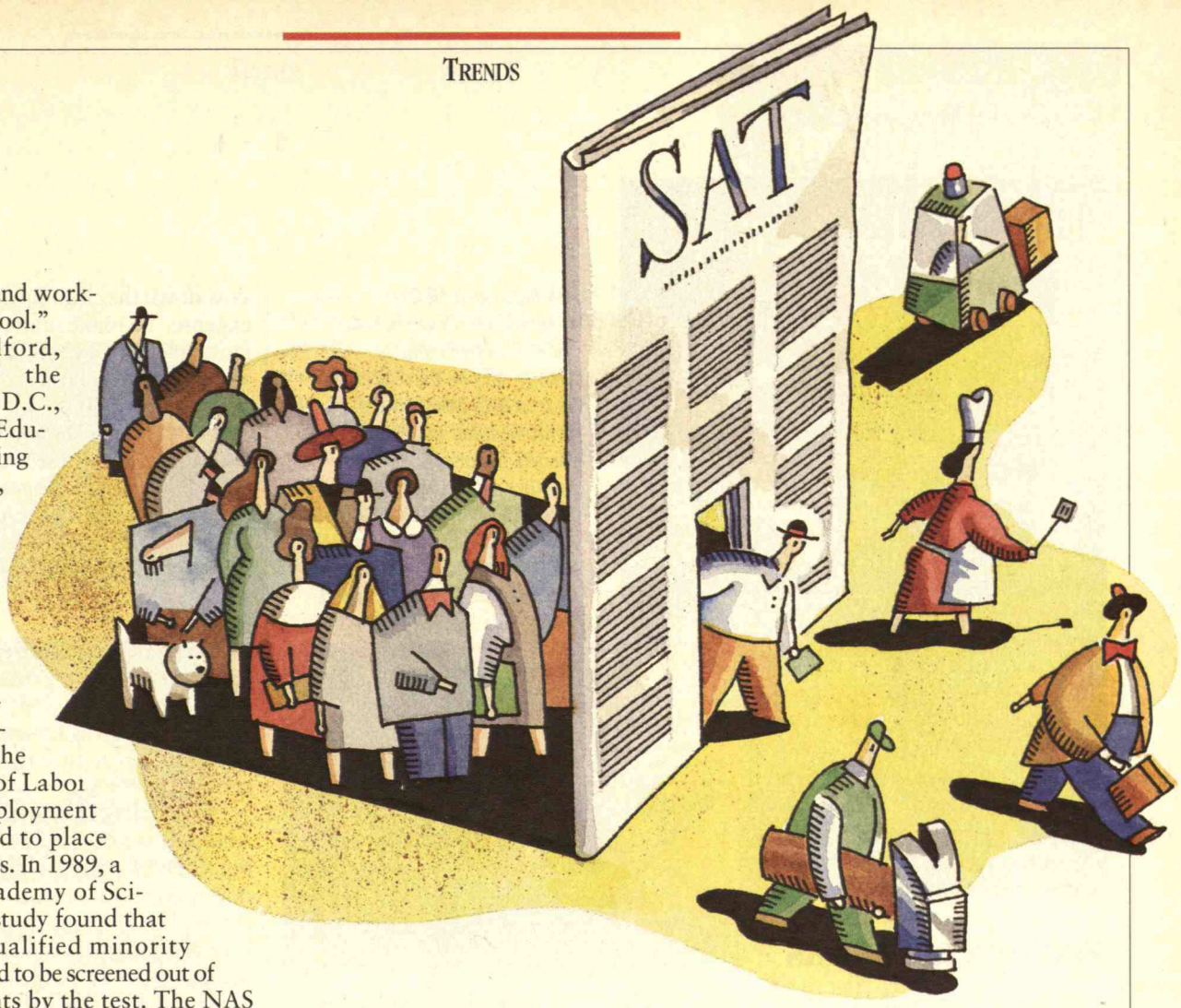


for studying and working hard in school."

George Elford, director of the Washington, D.C., office of the Educational Testing Service (ETS), notes that the closest the United States has come to a workplace SAT was the General Aptitude Test Battery, which the Department of Labor and state employment agencies used to place workers in jobs. In 1989, a National Academy of Sciences (NAS) study found that otherwise qualified minority workers tended to be screened out of job placements by the test. The NAS study recommended research to improve the test, and the Department of Labor has agreed not to expand its use of the test until the recommended research has been completed.

Other limits on testing also raise concerns about the value of workplace SATs. "The President's plan calls for school performance tests in mathematics, science, history, English, and geography," notes George Madaus, professor of education and public policy at Boston College. "You'd have a hard time matching performance on those tests to many entry-level jobs." Madaus has collaborated with John Staudenmaier, associate professor of the history of technology at the University of Detroit, to study testing.

A weak link between test results and job performance has been cited in the case of a precursor of workplace SATs that is very much in use: the Armed Services Vocational Aptitude Battery (ASVAB), which the Department of Defense administers to 1.5 million high school students annually. In 1976, more than 300,000 test takers mistakenly received scores high enough that they were inducted into the armed services. Once the mistake was discovered, the DOD found little difference between the performance of those whose ASVABs had been scored correctly and incorrectly.

Toward Technical Literacy

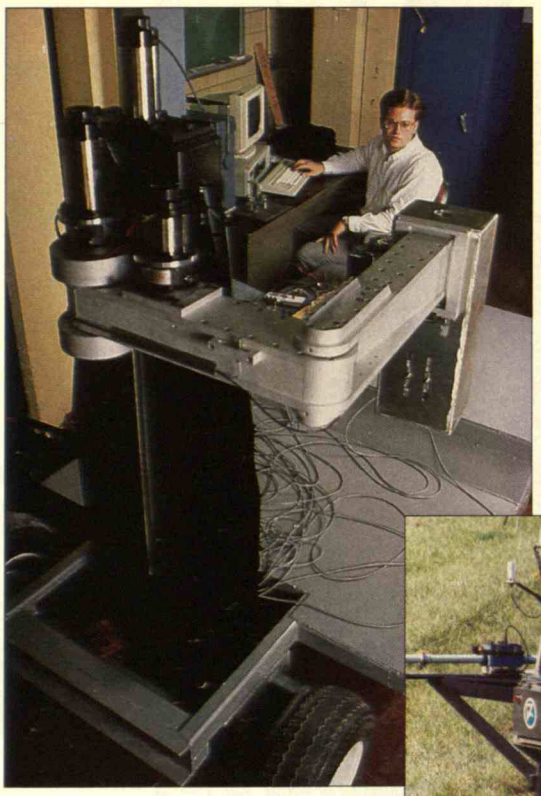
At American College Testing (ACT), which develops standardized tests, Kate Sottong, program associate at the Center for Work and Education, feels that the ASVAB, SAT, and GATB are limited because they compare test takers with one another. A fair test, she says, would be "criteria-based," measuring a person's absolute level of proficiency. "A well-constructed criteria-based test is color- and gender-blind," Sottong says. "If an employer says, 'I need someone with Level 3 in reading,' everyone can score 100 percent if everyone has reached the test level."

ACT is one of several groups developing nondiscriminatory tests that could aid both the nation in its quest for skilled workers and young people in the search for employment. For two years, ACT has been developing Work Keys, a prototype for a criteria-based workplace SAT covering such subjects as reading, writing, science reasoning, and the ability to learn. Collaborating with schools and employers to match skills and jobs, ACT is about to start pilot Work Keys programs in Wisconsin, Tennessee, Michigan, and Iowa.

The ETS, too, wants to work on criteria-based testing. With the help of state directors of vocational education, it is interested in developing Applied Academics, a set of high school curricula in applied physics, biology, mathematics, chemistry, and communications skills. These curricula "could be the foundation of workplace credentialing tests," notes Elford. "I do think we need a good test: a technical force needs a foundation of technical literacy."

—*Ann Marie Cunningham*

ILLUSTRATION: ROBIN JAREAUX



A robotic arm (left), designed by researchers at the U.S. Department of Energy, will be used later this year to help clean up the contaminated nuclear facility in Fernald, Ohio. Another robot (below), developed at DOE's Oak Ridge National Laboratory, can probe areas where radioactive waste has been buried.

Ecological Robots

Researchers at the Department of Energy (DOE), as well as in universities, industry, and other government agencies, are increasingly thinking that robots could take over ecological cleanups too dangerous or expensive for humans. The assignments range from removing leaking drums of toxic materials from contaminated sites to long-term monitoring of polluted facilities.

DOE's involvement stems from waste-management problems that are particularly acute. Its 17 major nuclear-production sites in 13 states include some of the most contaminated facilities in the nation, a burden growing out of a 45-year involvement in developing nuclear weapons components for the Department of Defense.

Using robots to handle risky jobs is not new—for example, a robot developed at Carnegie Mellon University helped assess radioactivity levels at Three Mile Island. Because much of the technology already exists, environmental robots could play a key role in restoration efforts soon.

This year, a project led by James Corones of DOE's Ames Laboratory at Iowa State University may show how robotic technology could make a dent in that department's waste plight. The scientists plan to hold the demonstration at a contaminated DOE facility in Fernald, Ohio.

To date, effective ways to reduce the threat from hazardous waste have usually been costly and time-consuming. For example, the Office of Technology Assessment has estimated that fully cleaning up a set of 13 targeted sites by traditional methods would take 50 years and cost $300 billion. But 28,000 hazardous waste sites have been identified in the United States, and nearly 2,000 of these are on the Environmental Protection Agency's Superfund list.

Currently, humans must perform such basic cleanup operations as sampling, testing, and removing soil and toxic materials. At especially toxic locations, workers can only stay on-site safely for a few minutes; some places are too dangerous for any human presence. The necessary precautions for humans slow down the clean-up and drive up the expense. To make matters worse, escalating insurance costs mean that fewer environmental contractors willingly undertake such jobs.

According to DOE scientist Stanley Wolf, many of these sites contain so-called mixed waste, combinations of radioactive and non-radioactive hazards. The contaminated mix may be stored in drums, silos, or underground storage tanks or strewn across the surface.

To handle such diverse, complex, and dangerous cleanups, robots offer many advantages. They don't tire, they can operate in places unsafe for humans, and they can reduce the possibility of accidents.

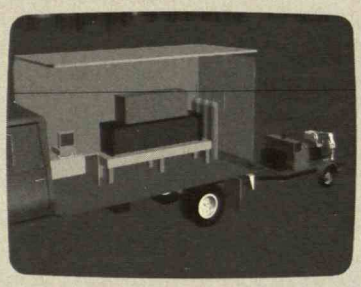
In fact, R&D on robots for environmental restoration is becoming a major DOE priority. Cleanup projects now account for one-quarter of the budget, and DOE plans to spend $100 billion over 30 years to clean up after its nuclear projects. In the next two years, says Linton Yarbrough, who heads the robotics branch of DOE's Environmental Restoration and Waste Management Program, $50 million will be spent on eight different robot systems at nine DOE labs.

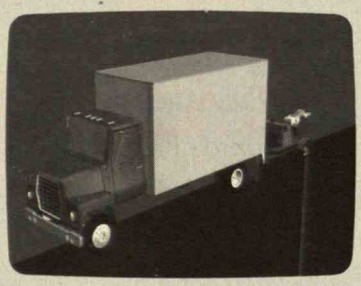
Robot on the Spot

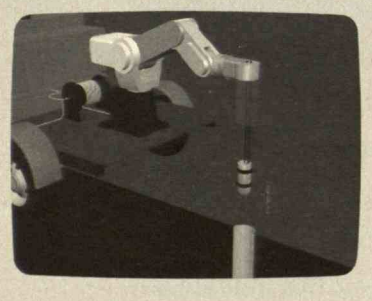
In Iowa, engineer Edward Jaselskis, chemist Arthur D'Silva, Corones, and others are combining their expertise to develop a way to gather, in short order, extremely detailed and precise data on all the contaminants at a site. Armed with the best available equipment, their robotic system would enter a contaminated location, collect samples, and analyze them on the spot.

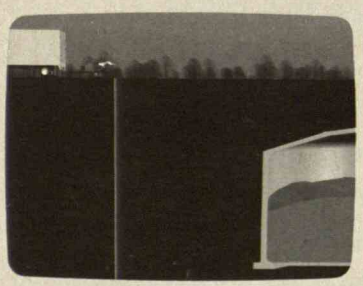
Initially costing an estimated $750,000, the system would replace the human task of tediously collecting soil samples that are then sent elsewhere for analysis. From a mobile enclosed room, technicians would remotely control the robot. The system could take samples from the surface or probe down 100 feet.

PHOTOS: AMES LABORATORY; OAK RIDGE NATIONAL LABORATORY









This animated sequence depicts a robotic system developed at the Ames National Laboratory that will sample contaminants in a groundwater well. Technicians inside a mobile trailer truck will operate the controls.

According to D'Silva, laser beams shooting through the probe will vaporize small amounts of the material to be tested, and a stream of argon gas would carry the samples back to the robot's analysis system. This approach would avoid the risk of spreading contaminants in an excavation.

Upon finishing one test, the robot would move over a bit to conduct another on-the-spot analysis. D'Silva says that within a few hours, the robot might complete a comprehensive sampling of all the varied surface and subsurface soils at the site.

When more extensive lab tests are in order, the robot could do a critical initial screening. That's important, Yarbrough explains, because sometimes it's not clear what hazards are where, due to poor record-keeping at the start of DOE's nuclear weapons work over four decades ago. But knowing exactly what is where is critical for remediation because a different process may be needed to try to neutralize each contaminant. Simply eliminating the time and expense of unwittingly sending clean samples out for analysis would contribute greatly to the cleanup process, notes D'Silva.

Even by a conservative estimate, says Corones, the robot unit could save half the cost of the sampling and analysis end of a cleanup. In some complex cleanup efforts, the cost of extracting and analyzing a single sample can run into the tens of thousands of dollars. Going further in the cleanup process, though, some DOE specialists think it's possible to couple the on-site analysis with the cleanup process itself. A single system might start removing the soil for reprocessing as soon as it determines the site is contaminated.

Ames scientists believe their unit will be manufactured commercially within three years. That likelihood is increased by the strong interest potential contractors already show in such technology. Lockheed Missiles and Space Co., for one, is expanding into environmental cleanups as the market for military contracting declines.

—MARY ROSE ANDERSON

ILLUSTRATIONS: ENGINEERING ANIMATION, INC./JIM TROY

The New Vaccines

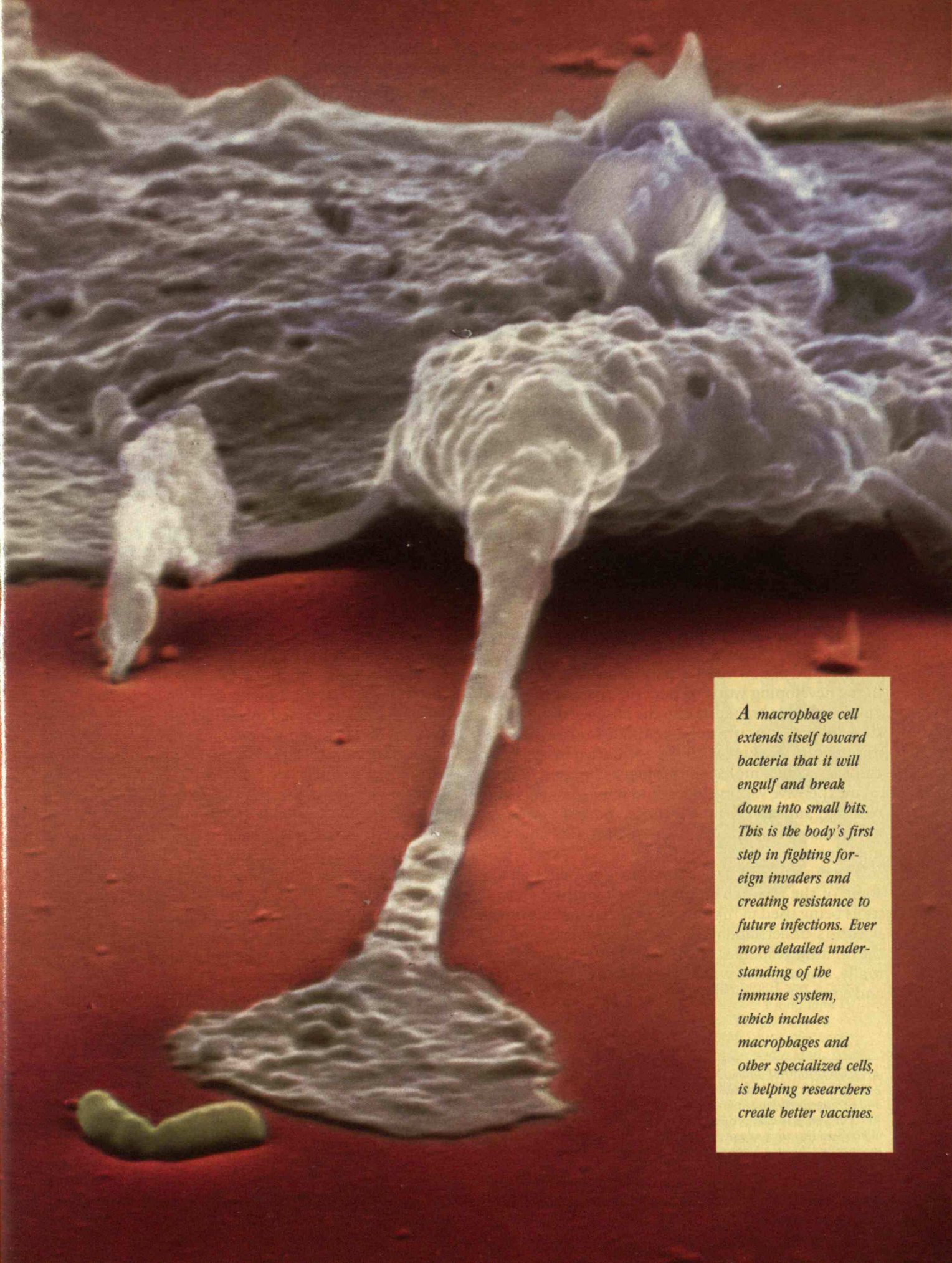
Novel approaches to developing vaccines could make immunization safer, prove particularly useful in the Third World, and possibly even battle AIDS.

EPIDEMICS of bubonic plague killed perhaps one of every four people in Europe during the Middle Ages. Tuberculosis was responsible for about one-third of all deaths in the United States and Europe during the nineteenth century. The 1918-19 influenza pandemic killed more than 21 million people worldwide and more than 500,000 in the United States.

Then came the widespread practice of childhood vaccination, and many people, at least those in industrialized countries, stopped thinking about deadly scourges. Perhaps that is one reason AIDS has so shocked the world. Suddenly another devastating virus appeared and began taking its toll—worldwide, 1 in 250 adults are infected; in the United States, 1 in 70 men. There is neither cure nor vaccine.

Now a revolution in the field of vaccine development, fueled by progress in genetic engineering and immunology, offers hope in combating AIDS and other pathogenic illnesses. For many years scientists developed vaccines empirically—mutating or killing disease-causing organisms and then testing whether preparations made

BY ANNA ALDOVINI AND RICHARD A. YOUNG



A macrophage cell extends itself toward bacteria that it will engulf and break down into small bits. This is the body's first step in fighting foreign invaders and creating resistance to future infections. Ever more detailed understanding of the immune system, which includes macrophages and other specialized cells, is helping researchers create better vaccines.

from them had the desired effect. But in the past 10 years, researchers have started coupling advanced theories about the immune response with recombinant DNA technology to design vaccines in a more orderly fashion.

Whether or not these efforts lead to a vaccine for AIDS, they are starting to yield other valuable vaccines. So far, at least two human vaccines created by new genetic engineering approaches—both for hepatitis B—are on the market. There is not even a remote chance that these vaccines could cause the disease they are designed to ward off, because they contain no complete pathogen. Nor could the production of such vaccines pose a danger to laboratory workers in the event of, say, a broken flask.

Bacteria have attached to a B lymphocyte, an immune cell that produces antibodies that inactivate invading pathogens. Molecular biologists can use the antibodies to identify antigens, the parts of a pathogen that trigger the immune response. The antigens' genes could prove useful in developing new kinds of vaccines.

One kind of new vaccine may be particularly useful in the developing world. There the costs of most vaccines and their breakdown in the absence of refrigeration make inoculation against many diseases impossible. Working with the agent used in the tuberculosis vaccine, molecular biologists hope to develop an inexpensive vaccine that could remain stable in hot weather and could in one dose, possibly given to newborns, prevent a number of bacterial and viral infections.

The theory behind such vaccines is new enough that some of the research strategies are tentative. But the tools being used in the new approaches are improving scientists' understanding of the biology of infection and the immune response. So even if a new vaccine fails initially, investigators will be better able to find out why and to make improvements.

ANNA ALDOVINI, a physician and postdoctoral associate at the Whitehead Institute for Biomedical Research, is studying the basic biology of and vaccine development for the virus that causes AIDS. RICHARD A. YOUNG, an associate professor of biology at MIT and member of the Whitehead Institute, advises the World Health Organization on tropical diseases and directs a National Cooperative Vaccine Development Group for AIDS, sponsored by the National Institutes of Health. He also holds equity in and sits on the scientific advisory board of MedImmune, a company mentioned in this article.

The Growing Knowledge of Immunology

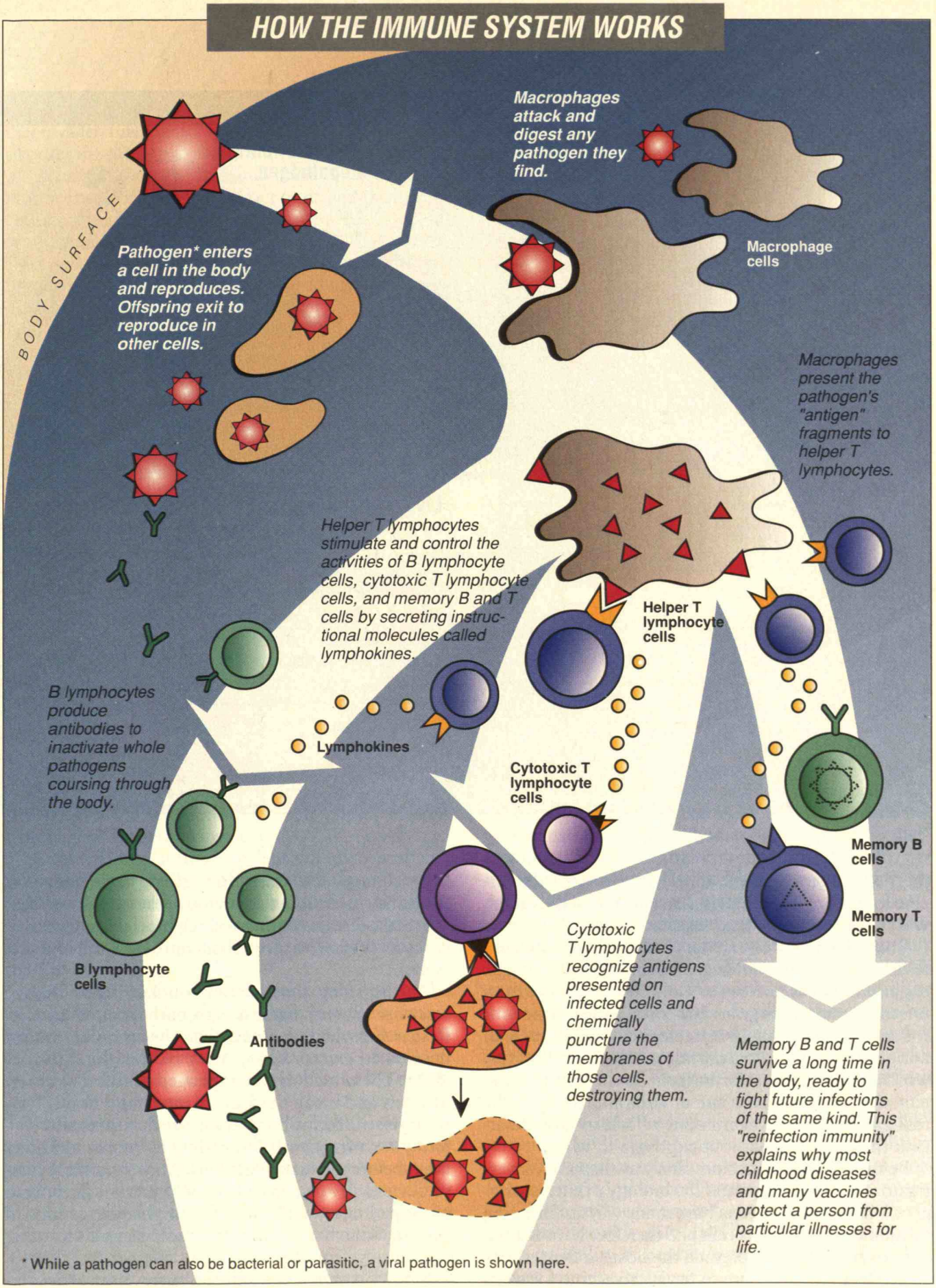
The World Health Organization estimates that 80 percent of the world's children are now vaccinated against measles, polio, tuberculosis, diphtheria, whooping cough, and tetanus. That translates into 60 million vaccinations annually. Despite the wide use of vaccines, however, scientists' knowledge about the immune response to infection has been limited. What's been known is that when an individual recovers from an infection, the person's immune cells establish a "memory" of the foreign agent. The memory, which the body can retain for a lifetime, allows the immune system to rapidly recognize the same pathogen in the future and swiftly kill it. This "reinfection immunity" explains why most childhood diseases are just that: one infection protects the individual, often for life. Molecular biologists have used this understanding to develop vaccines by mimicking infectious agents and generating memory for specific pathogens without producing disease.

Some vaccines in use, such as the one for measles and one of the two available for polio, consist of living pathogens that have been attenuated—that is, crippled—through laboratory-produced mutations, which prevent the pathogens from causing disease. The live bacterium in the tuberculosis vaccine, for example, is an attenuated strain of an organism closely related to the one that causes the disease. When the crippled organism reproduces in a person, it initiates an immune response—a buildup of antibodies and other agents that will destroy the genuine tuberculosis pathogen if it later infects the person. The response is triggered by "antigens"—certain structural components within the pathogens themselves.

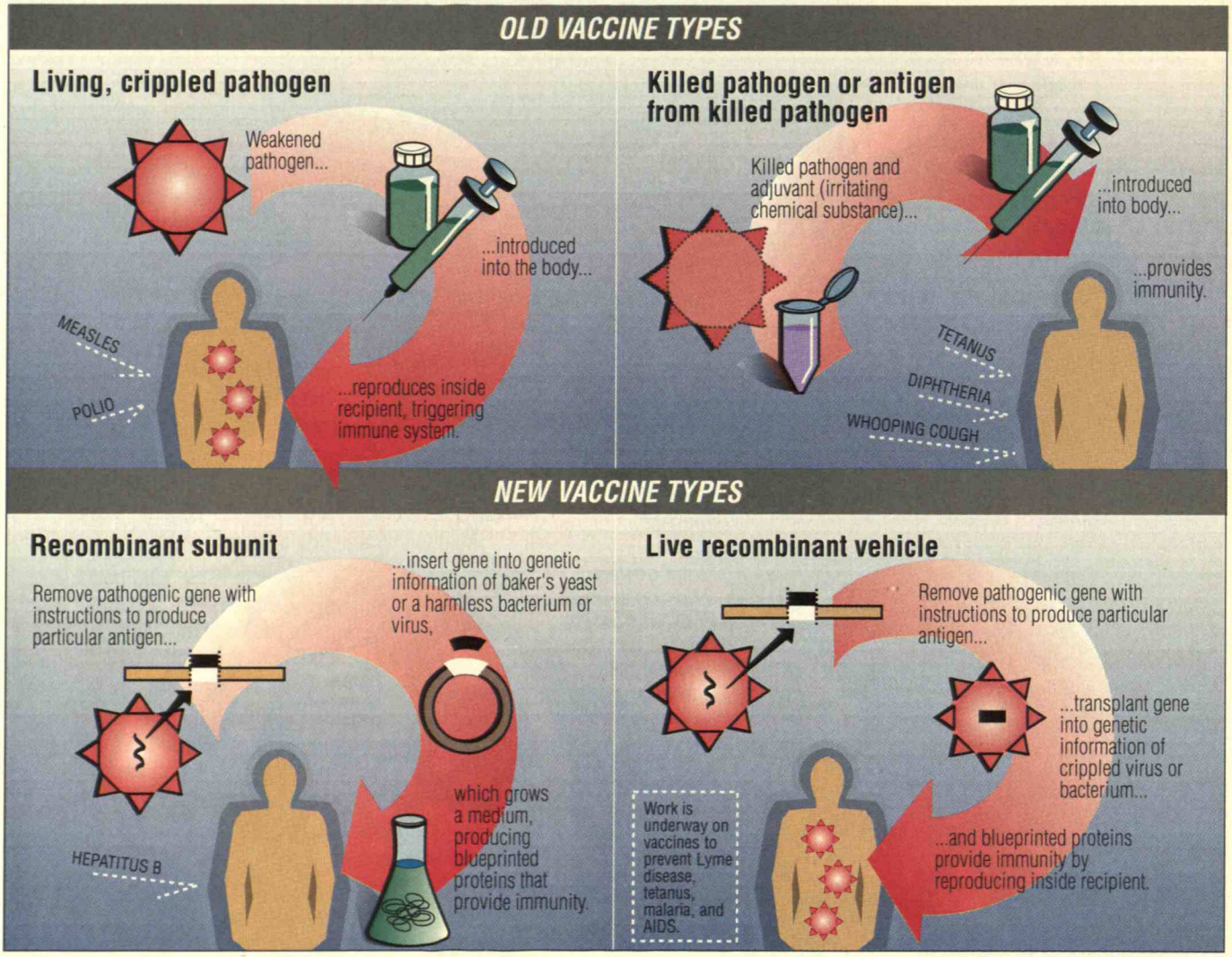
The other type of vaccine used widely today contains killed infectious agents. This kind of vaccine requires two parts: an antigen—usually a protein from the pathogen—and an adjuvant. The adjuvant is an irritating chemical substance that stimulates the immune system to investigate, respond to, and remember the antigen. The diphtheria and tetanus vaccines include

PHOTOS ABOVE AND PREVIOUS PAGE: LENNART NILSSON, BOEHRINGER INGELHEIM INTERNATIONAL; DIAGRAM: DEBORAH PERUGI

HOW THE IMMUNE SYSTEM WORKS



* While a pathogen can also be bacterial or parasitic, a viral pathogen is shown here.



purified antigens from the killed bacteria, while the vaccine for whooping cough is a suspension of the killed, whole bacterium that causes that illness.

But today many researchers believe that a new way to develop vaccines holds great promise: with genetic engineering tools, molecular biologists can isolate from infectious pathogens genes that contain the instructions for specific antigens. Investigators can insert such an antigen blueprint into a harmless bacterium or virus, which then produces the antigen. To the immune system, the harmless bacterium or virus appears to be the real pathogen, and the immune cells learn how to attack the pathogen without exposure to it.

Before designing vaccines this way, however, investigators have to understand the biology of each pathogen. Viruses and bacteria have many ways of invading the human body and its cells and therefore have evolved various mechanisms to evade the host's defenses. For example, if scientists are to devise a vaccine for sleeping sickness—a disease that afflicts 1 of every 100 Africans—they must learn how the organism that causes the disease continuously changes the antigen that coats its surface, a tactic that confounds the immune system.

At the same time, details on how the immune response protects against each pathogen are critical. Researchers have learned that the immune system deploys an extraordinary array of cells during infections. These include macrophages, which gobble up invaders and break them down into small bits. B lymphocytes make antibodies that attack viruses and bacteria, most frequently by binding to them and killing them before they can infect cells. And cytotoxic T lymphocytes kill infected cells to help prevent the spread of the pathogen, while helper T lymphocytes command the attack on the outsider by sending signals to other immune-system cells.

Since T lymphocytes and antibodies from people in-

DIAGRAM: DEBORAH PERUGI

fected with a pathogen recognize specific antigens of that invader, investigators can use lymphocytes and antibodies in searches to identify the dominant antigens of various pathogens. In many cases, these antigens produce the primary immune response, and their genes could prove useful in vaccines. Using a technique developed in the early 1980s by one of the authors (Richard Young), researchers can search through libraries of thousands of antigens produced by recombinant DNA sequences of a pathogen. After identifying the dominant antigens, molecular biologists can again employ recombinant DNA techniques to isolate genes and create vaccines.

Designing Vaccines

In 1986, the U.S. Food and Drug Administration approved a Merck Sharpe & Dohme vaccine for hepatitis B that was developed using this approach. The vaccine is safer than an earlier hepatitis B vaccine not only because it avoids the use of an actual pathogen, but also because it is not derived from human blood, which can carry other infectious agents, such as the AIDS virus. And the vaccine works as well and costs about the same as its older counterpart.

The new hepatitis B vaccine is known as a recombinant subunit vaccine. After identifying the gene for an antigen that is normally a part (or subunit) of the hepatitis B virus, researchers place the gene into baker's yeast in such a way that the yeast's genetic information starts producing the antigen as yeast cells grow. Then the investigators isolate the antigen from the yeast. (Antigens for other vaccines are being made in yeast or harmless bacteria as well.)

Recombinant subunit vaccines will also probably prove useful for protection against diseases other than hepatitis B. Researchers are making considerable efforts to identify good antigens for recombinant subunit vaccines to prevent Lyme disease, measles, and malaria, among others.

At the cutting edge of vaccine development is the live recombinant vehicle vaccine, which is made by incorporating a gene for a specific antigen into a living but harmless virus or bacterium which can, in turn, be injected into the body. The notion is that the live organism will manufacture and deliver the antigen to the immune system. Such vaccines should be more effective than recombinant subunit vaccines because they persist in the body for a longer period, presumably engendering a stronger memory for the pathogen. They should also be able to carry multiple foreign genes and therefore may allow simultaneous vaccination against a variety of pathogens.

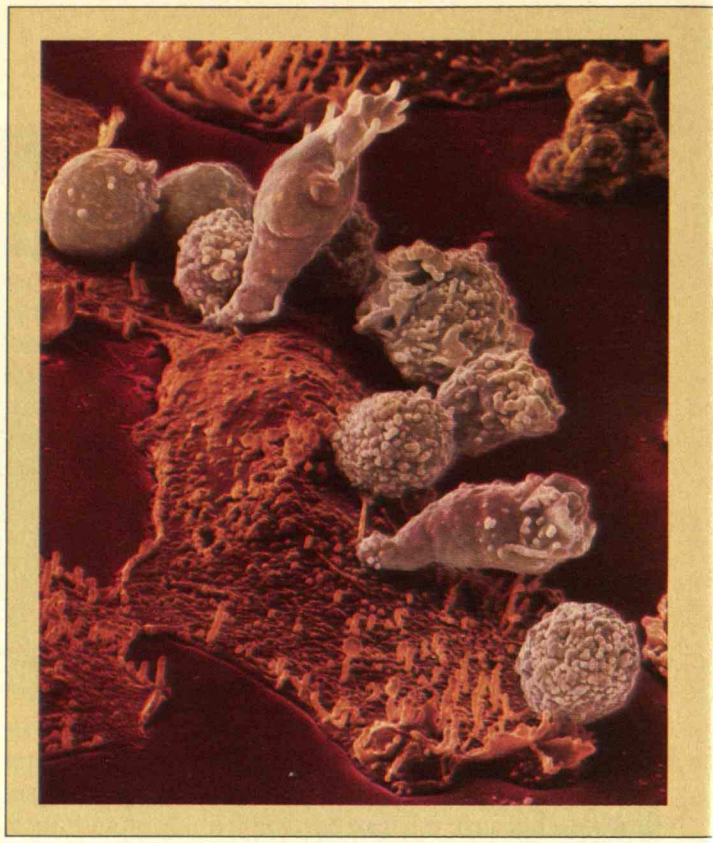
The primary concern among researchers interested in pursuing live recombinant vehicle vaccines is determining what kinds of "vehicle" organisms should be used with particular antigen genes. Some vehicles are better at stimulating antibodies, which are particularly important for battling certain pathogens. Other vehicles are best at stimulating T lymphocytes, which are needed to fight different invaders.

An antibody, outlined in blue, binds to an antigen, outlined in yellow. In traditional vaccines, which are made of dead or crippled pathogens, the immune response targets antigens.

Among virus vehicles, investigators have most extensively studied vaccinia, the organism that was originally used on its own as a vaccine against smallpox. One can easily introduce genes from most pathogens into the genetic blueprint for vaccinia. Similar investigations are also focusing on poliovirus and adenovirus, a virus that normally causes respiratory diseases such as bronchitis and pneumonia. There are attenuated strains of both viruses.

Some molecular biologists are also researching a bacterium called BCG. It has a long record of safe use as a vaccine against tuberculosis, with health-care workers having administered more than 2 billion doses. BCG's effectiveness derives from components in its cell wall that strongly stimulate the immune system and from its ability to continue growing in the face of a robust immune response.

PHOTO: JEAN CLAUDE REVY/PHOTOTAKE



A group of us at the Whitehead Institute, as well as scientists at Albert Einstein College of Medicine in New York and at MedImmune, of Gaithersburg, Md., have recently engineered BCG to contain genes for antigens from many pathogens, including those that cause Lyme disease, tetanus, and malaria. Mice have shown strong immune responses to recombinant BCG vaccines for these pathogens, and MedImmune has started similar tests in primates for the BCG vaccine for Lyme disease.

Several features of BCG suggest that it will make an ideal vaccine in the developing world. It's easy and inexpensive to manufacture: the cost is 5.5 cents per dose, and recombinant forms of BCG should not cost much more. The bacterium remains stable without refrigeration, there is already a worldwide distribution network for handling BCG, and the vaccine is easy to administer. And since BCG is one of the few vaccines that newborns can receive, recombinant forms could make effective childhood vaccines against a variety of diseases.

Another promising candidate for a vaccine vehicle is salmonella, a bacterium that normally causes food poisoning. Salmonella infects the gastrointestinal tract and stimulates an immune response that helps defend the body against pathogens that affect mucous membranes. For several years now, Jerry Sadoff and his colleagues at the Walter Reed Army Institute of Research in Washington, D.C., have been using crippled strains of salmonella to introduce genes from a variety of pathogens. Among other things, they have so far shown that the recombinant salmonella induces immune responses for malaria in mice and primates.

The Special Case of AIDS

While recombinant vaccines offer great promise, a disease that has helped fuel interest in the field—AIDS—is proving to be one of the hardest illnesses to combat. The very concept underlying vaccination, reinfection immunity, is not applicable for an infection from which there is no evidence that a person can recover. Researchers do not understand why the immune system can never rid the body of HIV, the virus that causes AIDS, once it has infected a few cells. If the immune system cannot mount an effective response, scientists may not be able to design an AIDS vaccine.

The major challenge to developing an AIDS vaccine may well be that HIV infects the very cells, the helper T lymphocytes, that control much of the immune response. HIV also introduces its own genetic blueprint into that of the T lymphocyte, making the infection of that cell permanent.

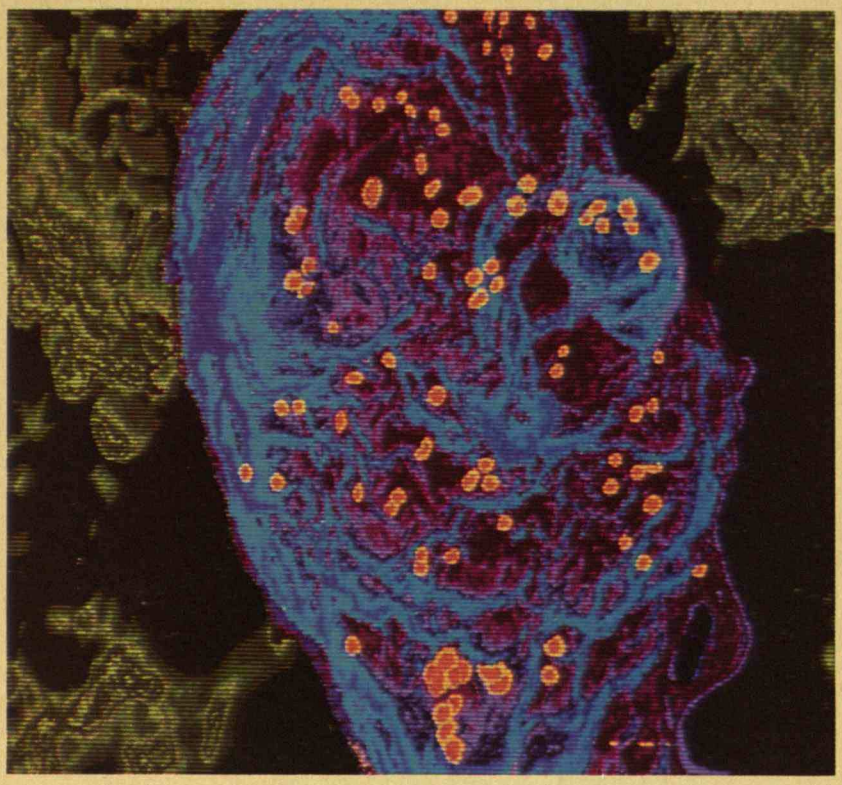
And unlike the way infected cells typically respond to most invaders, a fraction of cells carrying HIV may not produce the viral proteins that alert the immune system. Moreover, HIV can baffle the immune system by rapidly changing portions of its enveloping protein.

Despite these problems, we have substantial reason to expect that a human vaccine can be developed. After all, the immune system makes a strong effort to destroy the virus through the action of antibodies and lymphocytes. One idea, therefore, is to make an AIDS vaccine that stimulates the immune system to recognize and kill the virus before it can infect immune-system cells.

Indeed, independent of each other, both Ronald Desrosiers, a virologist at the New England Regional Primate Research Center in Southboro, Mass., and Michael Murphey-Corb, a microbiologist at the Tulane Regional Primate Research Center in Covington, La., have developed a vaccine that in some cases has provided immunity against the primate virus related to HIV. The vaccine is actually produced by one of the two older techniques: it is composed of the killed virus and an adjuvant, which stimulates an immune response.

About half the primates who have been vaccinated and later exposed to the live virus have not been infected. Investigators are now trying to understand why some but not all of the animals are protected, and they are attempting to develop genetically engineered vaccines to improve on the results and avoid the safety concerns arising from the possibility of an incompletely killed batch of virus.

For example, researchers have created two candidate recombinant vaccines for humans. One, developed by



Far left:
Cytotoxic ("killer") T lymphocytes, seen assaulting a cancer cell, destroy cells by chemically boring holes into them so that their insides spill out. Researchers think that these lymphocytes play one of the most important roles in destroying cells infected with the AIDS virus. They are trying to create vaccines that stimulate cytotoxic T lymphocyte development.

Left:
The major challenge to developing an AIDS vaccine may be that the virus (orange) can infect helper T lymphocyte cells (blue-red), which control much of the immune response.

MicroGeneSys, of New Haven, Conn., is a recombinant subunit vaccine consisting of the protein that envelops the HIV virus. The other—pioneered by virologist Bernard Moss of the National Institutes of Health and further developed by virologist Shui-Lok Hu of Oncogen—is a live-vaccinia recombinant vehicle that produces the same protein. The appeal of using this protein is that antibodies "see" it first. (Although the outer protein is known to change, investigators think that the kinds of variations may be limited.) Investigators will not know for some time whether either of the candidate vaccines stimulates enough of an immune response to prevent HIV infection.

Meanwhile, the Whitehead, Albert Einstein, and MedImmune researchers have produced recombinant BCG vehicles that carry genes for HIV's envelope protein and other major structural proteins. These candidate vaccines induce immune responses to HIV in mice. MedImmune is conducting similar tests in primates. And at Walter Reed, the Sadoff group has found that recombinant salmonella carrying genes for the HIV envelope protein induces immune responses in mice and primates.

Among the dozen or so other AIDS vaccine approaches that scientists are exploring is a technique called intracellular vaccination, which could help prevent most cells from becoming infected. The idea is to introduce into individual cells genes that destroy HIV's ability to reproduce, or that cause the cells to self-destruct when infected. For example, a vaccine might introduce a gene that would produce a substance that in turn would poison a cell when HIV invades it. Researchers cannot efficiently introduce such a vaccine into all the relevant cells of the body now, but gene-therapy research could eventually lead to a solution.

These new vaccine approaches—whether they will someday be used to combat AIDS or measles—obviously rely on high technology. But it's important to stress that disease control is not merely a matter of more and improved vaccines. Equally essential is the need to improve the conditions that can lead to serious pathogenic illnesses. This point was vividly brought home to us while visiting an Indian village. Dinner for one family there consisted of a few dozen grains of rice, gathered from the burrows of rats who scavenged for rice during harvest time. Poor nutrition makes people highly susceptible to disease.

The worth of the effort by the World Health Organization and UNICEF to vaccinate all the world's children by the year 2000 against measles, polio, tuberculosis, diphtheria, whooping cough, and tetanus cannot be overstated. Vaccines are the most cost-effective means of reducing disease, and many of the vaccines under development will likely play a valuable role in the not-too-distant future. But ultimately, programs to combat poverty, together with vaccinations to prevent specific diseases, are necessary to help maintain universal health. Many private foundations are making important contributions to combat nutritional problems in the developing world. Such efforts must continue, with help from other national and international agencies. ■

PHOTOS: LENNART NILSSON, BOEHRINGER INGELHEIM INTERNATIONAL; HERBERT WAGNER/PHOTOTAKE

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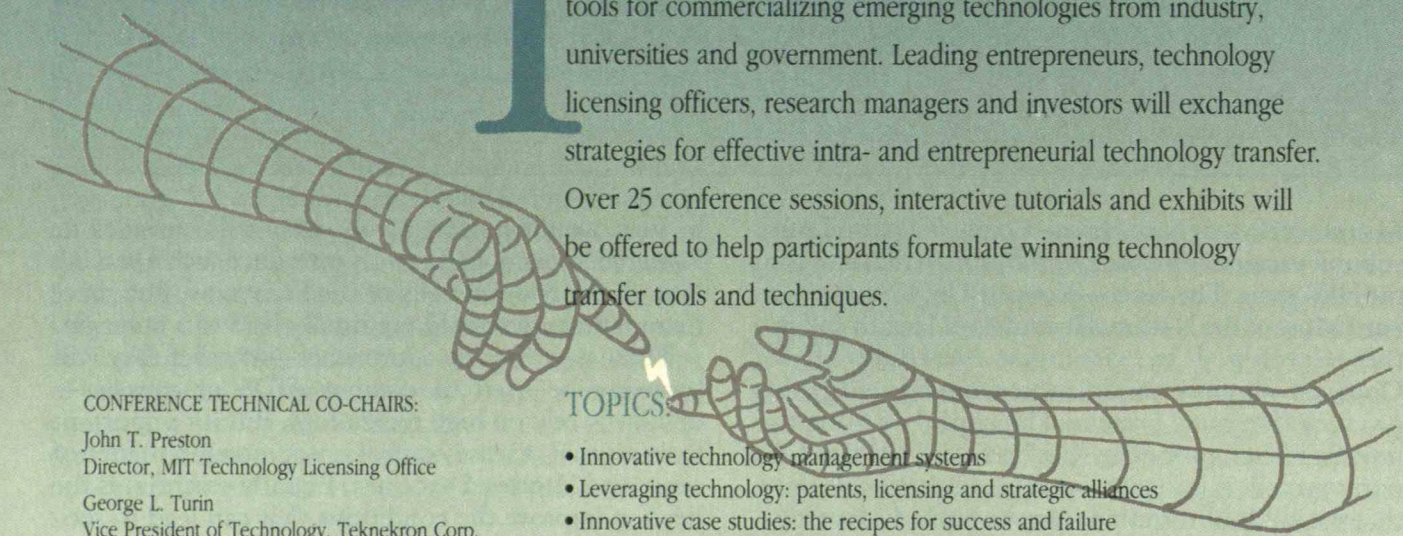

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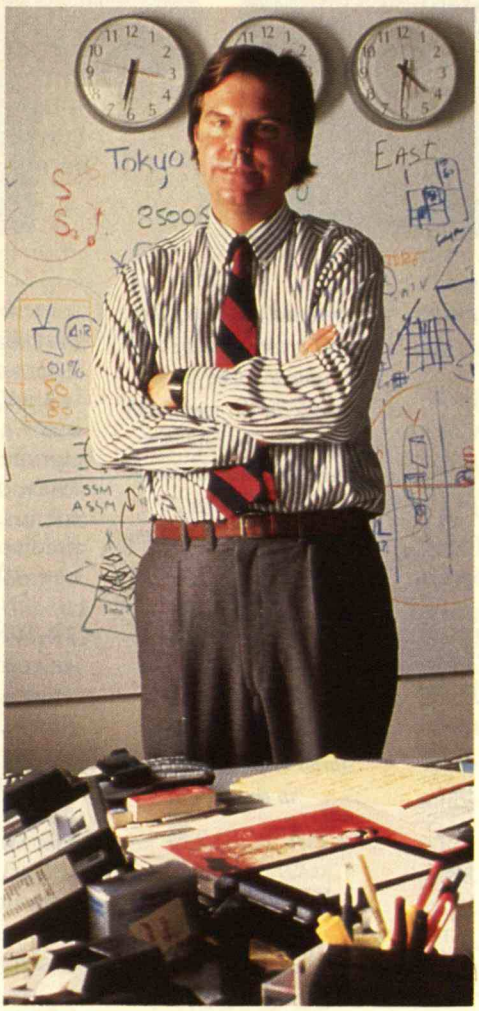
Machine Dreams

An Interview with Nicholas Negroponte

A VISIT to MIT's Media Laboratory will make you impatient about the rest of the world. You'll wonder about the wisdom of having a pound of newsprint dumped on your porch every morning when you usually read only three stories plus Dear Abby. You'll be irked by the neighborhood video store's limited selection when you see how it would be possible to transmit any of thousands of movies directly to your home, any time. You'll see exquisite three-dimensional moving images and wonder why your TV set is stuck in flatland. You'll see how computers can help kids learn in far more rewarding ways than the mind-numbing drill-and-practice routines that schools have generally settled for. And you'll return to your office utterly frustrated at computers that must be told everything, that require typing and clicking and other motions not found in nature, when you've seen machines that watch, listen, and behave like knowing servants.

The Media Lab is the child of Nicholas Negroponte, its founder, director, and chief visionary. In 1985, Negroponte, now the Wiesner Professor of Media Technology, united a group of diverse MIT research groups and gave them a common purpose: to devise new ways for people to interact with information. He was driven, in large measure, by the inadequacy and user-unfriendliness of computers and other information technologies. Personal computers, he maintained, were anything but personal.

Although today's computers are enormously more powerful than the ones



THE GUIDING FORCE BEHIND MIT'S MEDIA LAB WANTS PERSONALIZED TECHNOLOGIES TO KNOW AND SERVE THEIR HUMAN MASTERS IN THE MANNER OF AN ENGLISH BUTLER.

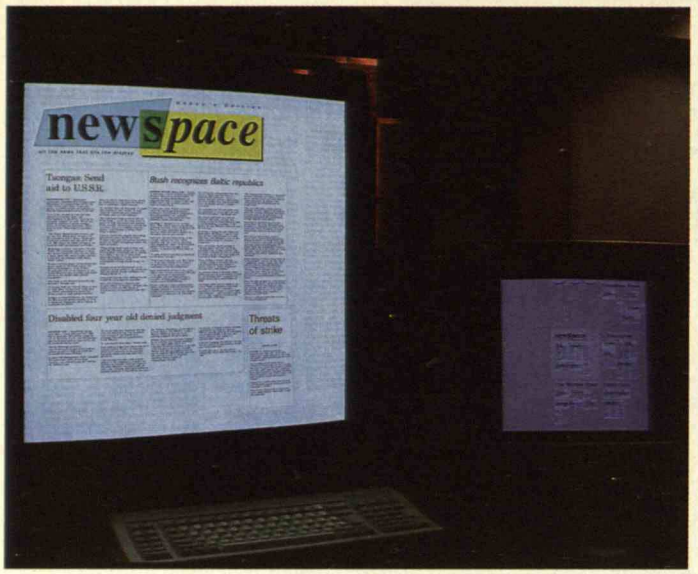
available even 10 years ago, Negroponte still has little use for them. He says that the Macintosh sitting on his desk, for example, is "sensory deprived, debilitated." He also has little patience for some of the household technologies that seemed so sleek and high-tech when introduced but that in fact are "really stupid implementations" of electronic technology. He admits to being deterred from programming a VCR.

The Media Lab, under Negroponte's guidance, is trying to invent a new world. Machines will see and hear and talk. They will also, after a fashion, think. Negroponte is not interested in creating a computer chess champion. He dreams of refrigerators that order milk before the carton is empty and of telephones that know to tell callers to try again tomorrow because you're having a bad day. He wants a computer that can figure out your interests based on what you choose to read—and then feed you a custom blend of information.

The Media Lab was created to dream, but its work appeals to more pragmatic types. About three-quarters of its funding comes from corporate sponsors; Negroponte sees the lab as industry's hired visionary, playing with ideas that are too audacious for a company to justify working on internally.

Negroponte caught a lot of flak after a *New York Times* article in December 1990 reported that the Media Lab had agreed, for $10 million, to help Nihon University in Japan set up a replica of the MIT facility. Critics charged that Negroponte was selling a crucial ingre-

PHOTOS: THE MEDIA LAB



dient of U.S. technological success to the country's major economic competitor. The intensity of this criticism underscores how the Media Lab has come to be regarded as a national treasure, symbol of U.S. technical and creative genius.

Negroponte has no degree in computers or engineering. He began playing with the ideas of personalized machines while a graduate student in architecture at MIT. After receiving his master's degree in 1967, he helped start the Institute's computer-aided design lab. At the time, computers were room-sized contraptions operated by experts; the idea of a personal computer—much less a personalized one that behaved as if it knew something about its user—was strictly science fiction.

Technology Review senior editor Herb Brody talked to Negroponte about the limitations of today's technologies and Negroponte's vision of the future.

A personalized newspaper would present readers with information that fit their interests. In this Media Lab prototype, the computer filters the day's stream of news for stories on preselected subjects—in this case, education, Canada, and the Middle East. Negroponte envisions a more subtle system that would deduce readers' interests based on what stories they have selected in the past.

TR: You started talking during the 1960s about how computers should be more powerful and easier to use. In what ways have your visions from that time been fulfilled—and remain unfulfilled?

NEGROPONTE: I wrote a book called *The Architecture Machine* in 1968, and that was the seed of many of the ideas that had to do with highly personalized systems—they'd "know" people very well and behave accordingly. Part of this vision has come to pass. Today people from all walks of life, of all ages, for all purposes, from recreation to business, are using computers as a part of their daily routine. There is now a ubiquitous computing environment—something that was unthinkable in 1968. The part that has not yet come true is the notion of a personalized system, meaning one that really knows you. I think of this personalized computer as something like a well-trained, long-standing English butler—someone intimately aware of your idiosyncrasies, your habits, your friends, your goals, and who you deal with. I predict that's what will be coming during the next 10 to 20 years.

TR: What is the Media Lab doing to personalize computers?

NEGROPONTE: One project that is very controversial is in the area of personalizing newspapers.

TR: This is where you tell your computer that you want to hear stories about particular subjects and it gives you just those stories? I would get the "Herb Brody news," and you the "Nicholas Negroponte news?"

NEGROPONTE: Yes, but it's got to be a little more sophisticated than that. You don't necessarily know in advance what it is you want to hear about. The computer must develop a model of you. And it's here that some people get worried. They think, Oh, my God, we're going to become a terribly narcissistic world because we're only going to get the information we want, and hence we're going to become narrower people.

TR: Why don't you think that would happen?

NEGROPONTE: Most people who think of personalized newspapers don't realize that there is a spectrum of styles of reading. Sometimes we limit ourselves to the major headlines, other

PHOTOS: THE MEDIA LAB

times we are looking for a much more serendipitous experience. You read a newspaper very differently Monday morning at 7 o'clock than you do Sunday afternoon.

On Monday morning, you'd probably be very happy to get the "Herb Brody edition," which would focus on matters of primary interest to you. But a system that is extraordinarily intelligent about you—one that truly knows you—can know that it's not always going to tell you and show you what you overtly want. It can know when to intermix oddball stories. So, for example, it might sprinkle the Sunday morning edition with items from all over. And it doesn't mean that it's only going to tell you and show you what you overtly want. It can be much cleverer.

TR: How would it know what you *might* want, when you haven't said so?

NEGROPONTE: Suppose you are reading this electronic newspaper on line. The system could infer from the time you dwell on particular stories how much of an interest you have in various subjects. So maybe you've been reading articles about government policy toward advanced television research. You might find that the system starts feeding you stories about rulings by the Federal Communications Commission, even though you never explicitly exhibited any interest in the FCC. And over time, it would learn more and more about you and so get better and better at figuring out what you want.

Systems that will prepare a personalized newspaper based on key-word selection are now on the market. But you don't get very far with key words. It still will take four or five years to get good working systems of the sort I'm talking about. We have a project at the Media Lab called "understanding news." Its goal is a system that will read massive amounts of news each night to prepare a personalized newspaper for you in the morning.

Ubiquitous Intelligence

TR: Despite the pervasiveness of the computer, it still seems possible today to live a full life without directly using one.

NEGROPONTE: Untrue. There is no human in the modern world that now uses less than a dozen computers a day.

TR: How do you figure?

NEGROPONTE: I'm counting home appliances, and office equipment like telephones and fax machines. Automobiles have a fair amount of computerization in them already, and more is on the way. In 1993, Nissan Motors will introduce a model that has over 50 microprocessors in it. Five years from now, people will use more than 1,000 microprocessors a day. In fact, you'll probably have a thousand of them just in your home.

"FIVE YEARS FROM NOW, PEOPLE WILL USE MORE THAN 1,000 MICROPROCESSORS A DAY—IN FACT, YOU'LL PROBABLY HAVE 1,000 OF THEM JUST IN YOUR HOME."

TR: So you're referring to the "computers" that are embedded in our environment rather than the machines with screens and keyboards that most people think of as computers.

NEGROPONTE: Yes. The fact that a few of those microprocessors are grouped together and called a desktop computer really doesn't distinguish them that much except that they are interconnected. When people say they can live a full life without computers, they probably mean that they can do without such things as electronic mail, a word processor, or a spreadsheet. But consider that those who as recently as three years ago had never head the word "fax" now can't live without one. They're in mom-and-pop restaurants, auto repair shops, and so on. And there's an awful lot of computing in that device.

TR: So these embedded computers are ultimately more important than the ones that sit on our desks?

NEGROPONTE: Yes, because they will be ubiquitous. And once these embedded computers start communicating with one another, then the home can become a very different kind of place. Your refrigerator, for instance, could tell your toaster that it's almost out of bread.

TR: Home automation products have so far had very limited commercial success. What makes you think people will want these kinds of "smart house" features?

NEGROPONTE: Because computers can deliver the services of a full-time maid, butler, gardener, chauffeur, and so on without the invasion of privacy.

TR: At present, most systems don't do much more than turn your lights on and off.

NEGROPONTE: Yes, or control security systems, or read the electric meter. It's all very mundane and quite boring.

TR: What are some more exciting uses?

NEGROPONTE: I'm coming home, carrying two fully loaded bags of groceries. Why isn't the front door opening up for me? That's a very easy thing to do. Another example: How many

times have you gone to the refrigerator and not found milk? Refrigerators shouldn't be allowed to run out of milk. They should monitor their contents and order more when levels dip below certain thresholds. And they also should be smart enough not to order three quarts of it when you're going on a camping trip the next morning. So there has to be interconnection: the computing agent that knows about your travel plans has to be connected to your refrigerator.

TR: What else could your intelligent house do for you?

NEGROPONTE: You have to remember that in the world I'm thinking of, these machines can see, they can hear, and you can talk to them. I find that the most constructive way to think about computing in the home is to think of human servants and what they did in the old days for the plutocracy of this world.

TR: How might my computer servant take care of me in humanlike ways?

NEGROPONTE: If your telephone really knew you, it would probably know when to ring and when not to ring. It would be able to see you and have an understanding of what was going on. So if you were in the middle of dinner, or diverted by some domestic crisis, the phone might query the caller and assess the purpose of the call, then decide whether to interrupt you. So instead of ringing, the phone could determine, "He's in a really bad mood right now, the kids are on his nerves," and tell the caller to call back tomorrow. A good butler would do that. A good telephone should do that too.

TR: But will people want to entrust to the telephone that kind of intelligence?

NEGROPONTE: Who cares if it's a telephone or a butler? There are certain things you clearly wouldn't entrust to a human, either.

Measuring the Impact

TR: It sometimes seems that people's ability to use computers productively has not kept pace with technological advances. Office productivity, for example, is not much higher now than it was 10 years ago.

NEGROPONTE: A lot depends on what you're measuring. If you look at the number of letters typed per day, or some such banal measure of office work, you're destined to find small differences. But you've got to look at what have been the big shifts in the way we do business as a consequence of technology.

TR: What kind of shifts are you thinking of?

NEGROPONTE: Where we see improvements by factors of two, or by orders of magnitude, is in the way technology is liberating people from space and time constraints. I have the misfortune of traveling an awful lot—I travel probably four days out of five, and I'm often gone weeks at a time. But when I come back to this office, my desk is empty—because everything, down to the telephone messages, has been answered in my absence by me personally or by somebody with whom I've interacted electronically. People can communicate with this office and get the kinds of responses they'd get if I were here—even though I might be in Hong Kong.

And electronic correspondence has inherent advantages, even if the sender is down the hall. Because it's interactive, in the sense that there's a pretty quick turnaround, you can easily ask the sender to clarify or elaborate on what you've received. It's also more readable—even the simple use of different type fonts tells me more about the message, so I presumably can be more insightful about it. I can't imagine how you'd come back and measure that against the way things were before.

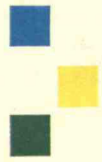
TR: What other examples can you cite where information and communications technology have brought genuine benefits?

NEGROPONTE: Wireless communications, such as cellular telephones. This is an area of extraordinary growth, one for which the 1990s will be known. I remember how people used to complain about the pile of pink telephone messages, which they now happily answer from the car. Other people use radio frequencies to receive timely stock quotations on a pocket-sized terminal.

TR: Such technology seems to be flooding us with information. Do we run the risk of "information overload"?

NEGROPONTE: No, we don't. One reason is that more and more, in many electronic media, people are writing things in a way that is very abbreviated, but where the reader can say, "tell me more."

TR: You mean hypertext?



"IF YOUR TELEPHONE REALLY KNEW YOU, IT WOULD KNOW NOT TO RING IF YOU WERE IN THE MIDDLE OF DINNER OR A DOMESTIC CRISIS."

NEGROPONTE: Right. So you don't have to see the whole thing strung out all at once and right from the start. You can first see an abstract, in abridged form. And then, if you want, you can open it up and get many more levels of detail. I personally don't experience an overload because I've got a number of talented people who read things on my behalf, so what I get on my desk is sort of predigested. Someone may have gone through it and highlighted key sentences, for example. Because these people know me very well, they even bring me little things—like an article somewhere that mentions an obscure Swiss hotel that I recently enjoyed staying at.

Negroponte maintains that computer games and toys are training a generation of more "technologically comfortable" people. Children can create new "creatures" using the Media Lab's LEGO/Logo system.

TR: Of course, most people don't have the luxury of a staff to filter their information.

NEGROPONTE: True, but as we discussed, a lot of that reading and highlighting could be done by a computer that knows what's relevant and interesting to you. At the Media Lab, we're trying to build machines that can do this sort of thing.

Information Inequality

TR: With its state-of-the-art gadgetry, the Media Lab sometimes seems removed from the reality of a world in which so many people have trouble working their VCRs—

NEGROPONTE: Including me.

TR: —and even more are intimidated by computers. Are we seeing the formation of a subclass of people—the "technology disabled"—who can't seem to get the hang of the new information technologies? Will this lead to greater social inequality?

NEGROPONTE: If the world stood still, then we would end up with the situation you're talking about. But we are progressing. Not that today's desktop computer is anywhere near good enough—on a scale of one to ten, it's still down around one, or maybe one and a half. But its score is steadily improving. Demographics are changing too.

TR: How is that going to help?

NEGROPONTE: Just look at where Nintendo and similar computer games are found. They are not all in white, upper-middle-class suburbia. The phenomenon cuts through all sections of the country, virtually independent of race and social class.

TR: Does playing Nintendo really prepare kids for using "real" computers?

NEGROPONTE: Sure. They become accustomed to the electronic milieu.

TR: So you think that games and toys are training a generation of more technologically able people?

NEGROPONTE: I wouldn't call it technologically "able" so much as technologically "comfortable." Look at joysticks, for example. Fifteen years ago people didn't even know what they were. Now they're practically as commonplace as telephones.

TR: What about the grown-ups who find it harder and harder to function without learning new skills?

NEGROPONTE: People are almost always reticent to become involved with something they don't know anything about. And as we get older, we seem to be less willing to expend energy to learn new things. But this varies from individual to individual. I was recently told of someone's elderly mother taking to the Macintosh like a duck to water. The computer gave new meaning and value to her life. I have heard countless similar anecdotes, which suggests that the issue is attitude, not skill.

Ending Sensory Deprivation

TR: What are the chief shortcomings of today's desktop computers?

NEGROPONTE: Probably the most dramatic problem is that computers are sensorily deprived, which leads to an asymmetrical environment.

TR: What kind of asymmetry are you talking about?

NEGROPONTE: Well, the output side of

PHOTO: HIROSHI NISHIKAWA

computing has really gotten better. There's some richness in the ability of the computer to express things, using video and color and sound and relatively nice graphics. But the ability of machines to receive information from humans is just terrible. At best, you sit there with a stupid mouse pointing at things, and typing.

TR: I assume that you want to talk to your computer.

NEGROPONTE: I want to talk, I want it to know where I'm looking, I want to be able to nod and smile, to do all sorts of things. I want face-to-face contact with that machine.

TR: Many labs are working on speech recognition technology.

NEGROPONTE: Yes, but they're going about it badly. Speech-recognition research has focused too much on the problem of understanding natural language. But one could imagine a lot of powerful applications of speech recognition that don't require sophisticated linguistic understanding.

TR: For instance?

NEGROPONTE: We frequently use speech to deal with something in passing, not to avoid typing. For example, I'd like to be able to turn around at my chair and say to my machine on the other side of the room, "Do I have any important mail?" I could even train myself to just say, "mail." And the computer could answer, "You've got three messages, but one is from Dr. [Charles] Vest [president of MIT], and maybe you'd better come look at it." It would be as if there were a person over there dealing with my question.

TR: How does this differ from what most speech-recognition researchers are aiming for?

NEGROPONTE: What they're working on right now is much more ambitious—they're trying to build machines that could turn our whole spoken conversation into a printout. They'll get there, but it will take a very long time. Also, most speech-recognition work doesn't take advantage of the fact that speech is highly interactive.

TR: Mm-hmm.

In synthetic holography, computer data are converted into a three-dimensional image. The Media Lab is pioneering this technology, which could someday serve as an engineering or architectural design tool.

NEGROPONTE: For example, you just produced speech that no linguist would ever call speech, but it's very important. It's a "para-lingual," as we call it. It has no linguistic value, but it helps the conversation. If we were talking on the telephone, and you didn't say, "mm-hmm" periodically, I'd get annoyed and finally ask you if you're there. Face to face, you can do a number of things—you can nod and smile, which is sort of the visual equivalent of "mm-hmm." Those are very important—but you can't look them up in the dictionary.

TR: What else would your ideal computer have, besides ears?

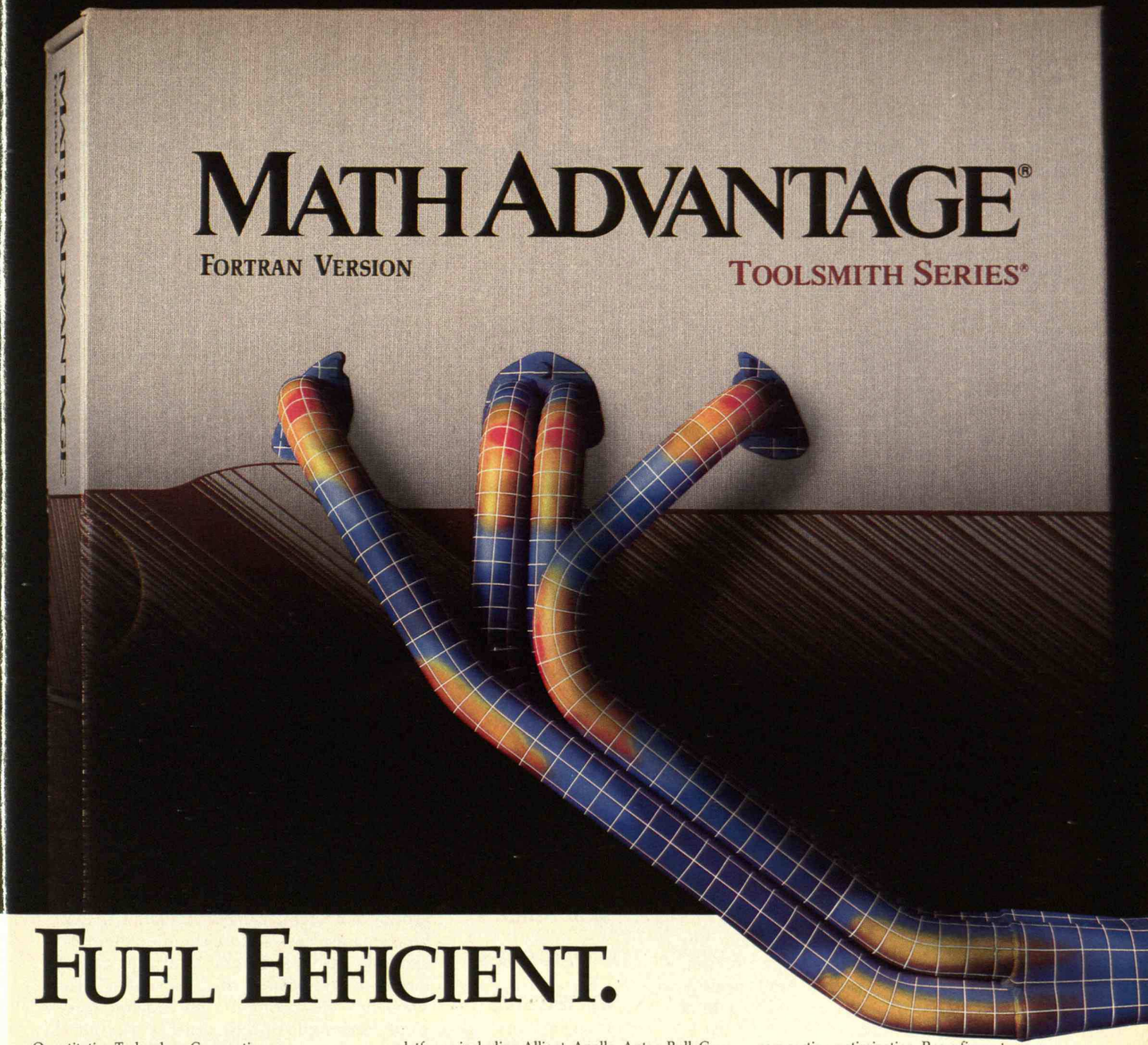
NEGROPONTE: Well, you can do an awful lot with eyes—a machine that could see your hand gestures would have a head start in understanding what you mean, for example. And of course we'd have good speech production, so the machines could talk to you in a humanlike voice.

TR: What about tactile input? The Media Lab got a lot of publicity recently for the "Dataglove," which translated hand motion into electronic instructions for a computer.

NEGROPONTE: The Dataglove is merely an expedient—it's purely a temporary way of running experiments that use hands and gestures. Nobody wants to wear a glove to use their computer. You want your computer to see your hand gestures, the way a person does. Since computers can't do that yet, we built the Dataglove. It lets us collect the data without the sophisticated vision system that would otherwise be required. But it does not represent what we think people will use in the long run.

TR: If you don't think people will be willing to wear something as modest as a glove, what do you think about the prospects for so-called "virtual reality"? These systems let you play in a totally made-up space, but they usually require donning helmets and visors and even body suits.

NEGROPONTE: Virtual reality may or may not be important to the future of computing. It will certainly be an important part of the future of entertainment. The idea is almost 30 years old, but there's a bandwagon right now. We don't



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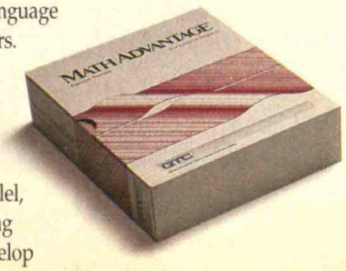

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even claim to be working in the area, even though many people in this laboratory have been involved with it for decades. Fifteen years ago, for example, we did some work to simulate driving through cities using images stored on a videodisc. We never called it virtual reality, but that's what it was: You could "drive" through the streets of Aspen, and look into windows. So I wouldn't dismiss virtual reality— but I'd let the bandwagon go by first. One challenge for a lab director is to distinguish between the annuals and the perennials.

Hired Visonary

TR: The Media Lab took a lot of heat for supposedly "selling out" to the Japanese—you struck a $10 million deal to help Nihon University create their own version of the Media Lab. Don't you think there is a danger that you'd be giving the Japanese a boost in one of the key areas of technology in which the United States still holds a lead?

NEGROPONTE: The agreement you're referring to was initiated in 1985 by a U.S. Congressional committee chaired by Richard Gephardt, who is not known for selling out to the Japanese. The idea was to build deeper cultural bridges and establish a real two-way street for ideas. There was never a pretense that the Japanese facility would be a clone of the Media Lab, merely that it would be fashioned after the Media Lab's style of research.

In any case, the original plan has changed dramatically to include the participation of a broad spread of premier universities and major U.S. companies, all coordinated by an international, nonprofit organization. As in any well-structured collaboration, we stand to gain at least as much as we give.

TR: What proportion of your budget is from corporate sponsors?

NEGROPONTE: This year will be 75 percent, which is down from 80 percent.

TR: It would seem that such a heavy reliance on industry would drive you toward more short-term projects. Or are you acting on a sort of visionary for hire?

NEGROPONTE: Yes. Companies pay us to do what they don't dare do themselves. They can cut our funding a lot easier that they can slash a lab with 50 people in it. They do the short-term work much better inside.

TR: Why should a lab so devoted to applications be at a university? Doesn't the kind of work you're doing here belong more in the research labs of the computer and entertainment companies that will profit from the results?

NEGROPONTE: No. The time horizon is too long for private industry, and the risk is too high that nothing will come of it. For example, you would not find an industry involved right now with synthetic holography, which is an enormously promising technology for producing three-dimensional images directly from a computer. There won't be a payoff for 10 to 20 years.

TR: But not all your work is that far from the marketplace.

NEGROPONTE: That's true. For example, we also are working on ways to pump video signals down a 1.2-megabit-per-second communications channel. This would permit transmission of movies to homes using existing telephone wires, with picture quality better than that from today's VHS videocasettes. For many applications—even near-term ones—you need the creativity and blends of talent that just don't exist in industry but are found at a university. But we're very self-conscious about not doing what industry can do.

TR: Have many Media Lab developments become commercial products?

NEGROPONTE: The lab, as presently constituted, is only six years old. The various MIT groups that later became the Media Lab developed many pieces that are common today. For example, the idea of a graphical computer interface based on the metaphor of a visual "desktop"—now common on Macintoshes—came from some of this earlier work. But already, some of the achievements of the last four or five years have migrated into products. Probably our single biggest contribution has been the idea of blending text, graphics, video, and sound—multimedia computing.

TR: What is the biggest challenge you see to realizing the Media Lab's visions?

NEGROPONTE: Making computers with common sense and understanding. And to do that, we need to understand understanding itself. Today, computers push bits and pixels around with no knowledge of what they are. But as soon as signals have a sense of themselves, and communication channels can recognize content, we can begin to build truly personalized systems that filter and fashion information for an audience of one. ■

"THE ABILITY OF MACHINES TO RECEIVE INFORMATION FROM HUMANS IS JUST TERRIBLE. AT BEST, YOU SIT THERE WITH A STUPID MOUSE POINTING AT THINGS, AND TYPING."

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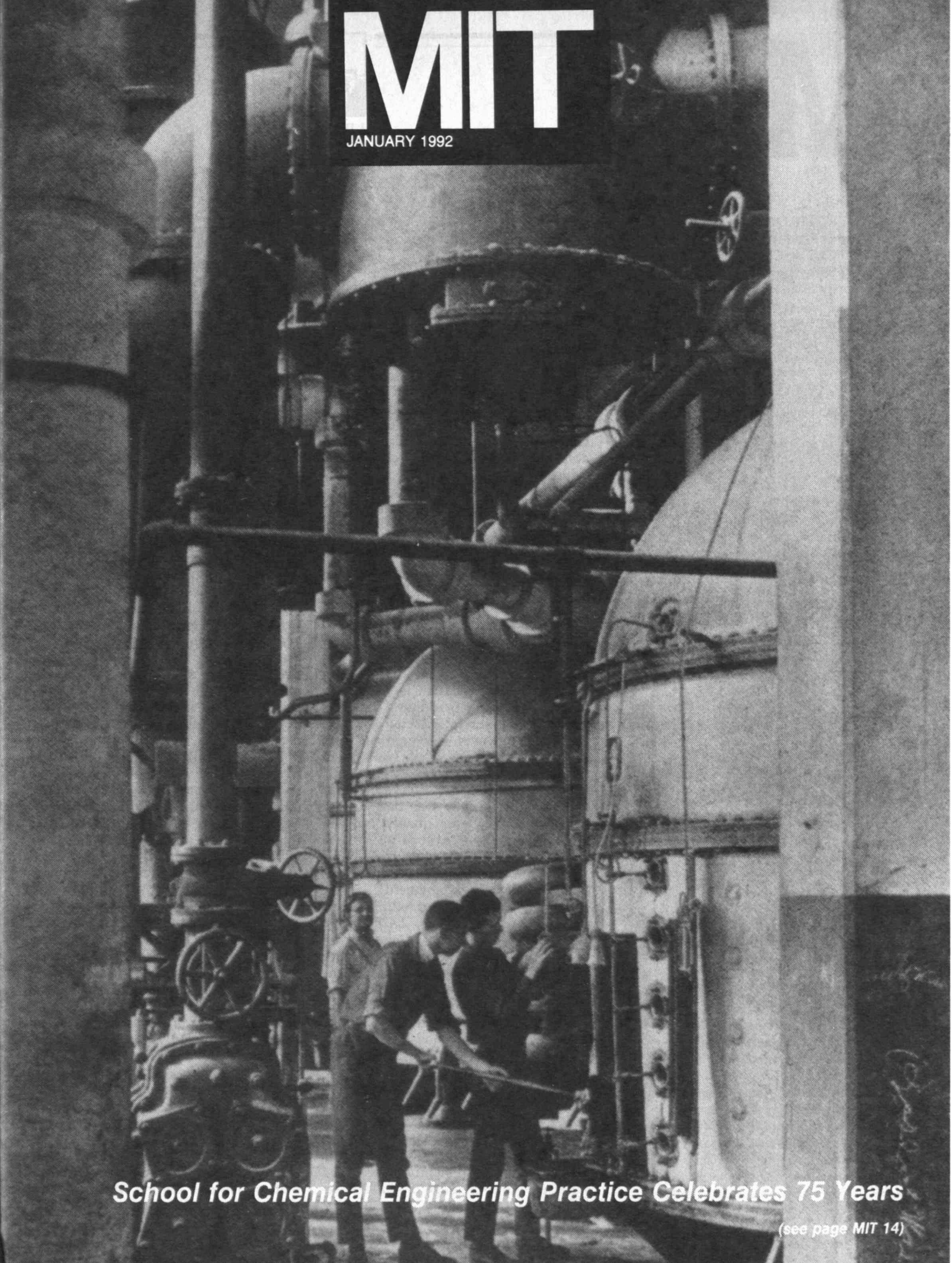

School for Chemical Engineering Practice Celebrates 75 Years

(see page MIT 14)

MIT
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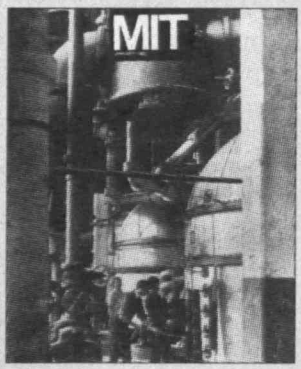


COVER
MIT's highly successful School of Chemical Engineering Practice was launched in 1917, and some of the first students to participate learned the intricacies of sugar boiling and "graining" at the Revere Sugar Refinery in Boston. Then, as now, the Practice School afforded students a chance to work at a scale and intensity no campus experience could duplicate. See article on page MIT 14. Photo from the MIT Museum.

UNDER THE DOMES

Clustered at the Top

The wry adage about "lies, damned lies, and statistics" might have been coined as a well-deserved whack at the surveys that magazines commission to set the national pulse aflutter. So when *U.S. News & World Report* ranked MIT sixth overall out of 25 top universities in their 1992 College Guide, the survey design understandably drew mixed reactions from the MIT Office of Admissions.

"Whenever you try to measure something as complicated as an academic institution, you're going to miss a lot of little things," said Michael Behnke, director of admissions.

Indeed, the fifth annual survey of "America's Best Colleges" in the September 30 issue, overlooks many features one might hope to see weighed before handing around any prizes. Curriculum, teaching philosophy, and the vicissitudes of student life don't count at all in the yearly rush to judgment. Similarly, a category dubbed "student satisfaction" merely reflected the percentage of freshmen who graduate from a school within five years. No student opinions were solicited.

Those who read between ratings will find that the survey was designed to measure not academic quality, but academic reputation. According to *U.S. News & World Report,* this hazy buzzword is the key that opens doors to graduate schools and employment.

In an act that smacks of setting the fox to guard the hen house, 2,425 college presidents, deans, and admissions directors were asked to issue points for academic reputation to schools in the same category as their own. Thus, among the top 25 universities, Harvard helped determine the standing for Yale, while Yale, in turn, rated Harvard.

"This is ridiculous," said Behnke, summing up the situation neatly.

Sour grapes? Hardly. MIT tied with Harvard for first place honors in academic reputation. On the whole, in fact, the survey casts MIT in a flattering light.

On questionnaires that fed into the final rankings, each institution recorded data such as percentage of students receiving financial aid, median SAT/ACT scores, acceptance rate, and student/faculty ratio. There was room for significant variation in how schools arrived at some of the figures supplied. Acceptance rate, for instance, was used here to help measure selectivity. It tallies how many students apply to an institution in a given year, are accepted, and actually enroll. But in making the count, speculated Bette Johnson, associate director of admissions at MIT, some schools may have included wait-listed candidates who eventually enrolled, while other schools did not.

The minuscule differences—less than five percentage points—among overall scores awarded to the top 10 contenders didn't worry the MIT Office of Admissions. But there was some concern that this survey and others of its ilk be taken with a grain of salt by prospective students and parents searching for the best academic match.

"Keep in mind that this is all part of America's mania for ranking things," advised Behnke. "It should be the least important thing students and families use in deciding where to go to college."

Larry Litten, associate director of the Consortium on Financing Higher Education (COFHE), a research and policy analysis group for 32 member institutions including MIT, believes that the *U.S. News* survey is as conscientious as any, but the rankings do a disservice to students and to institutions, for two reasons. One is that the differences between closely ranked schools are so small. He has suggested to *U.S. News* that they adopt an emphasis similar to that of *Consumer Reports.* When it rates

products, it states that quality differences between closely ranked models are judged insignificant. Litten also says that the rankings do not really get at academic or social realities—how the curriculum is crafted, for example.—*Francesca Coltrera* □

Solar Car Club Update

Since the departure last year of James Worden, '89, whose name was synonomous with solar cars throughout his undergraduate career, the MIT Solar Electric Vehicle Club is humming right along. Its members continue to rack up impressive results in the assorted races they enter at home and abroad, but available sunshine is, as always, more plentiful than sponsors. While scrap material isn't hard to come by, the crucial stuff like storage batteries and solar cells is not in the "surplus" category that individuals and companies are most eager to donate. The students, alumni/ae, and other "friends of MIT solar" who constitute the club often have to kick in their own money to keep the projects alive.

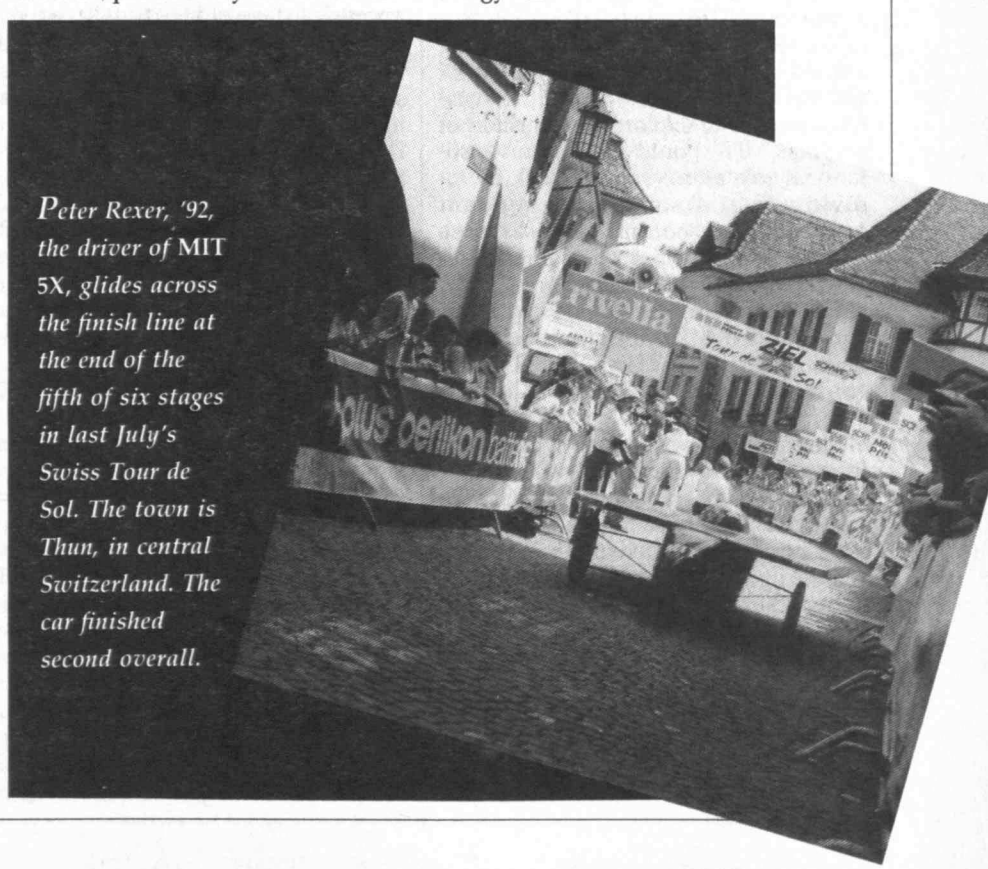
The club's primary goals are twofold: to improve solar-electric vehicle technology and to increase the awareness of alternative forms of energy. They are currently developing their first commuter car, the Aztec, which they hope to complete in the coming year. Aztec, a two-passenger car capable of maintaining highway speeds, will be solar-powered with battery assist, as are the three racing cars the club has built in the last few years. The batteries, which store collected solar energy, actually run the car. They can also be recharged by being plugged into a conventional electrical power source.

On the education front, the solar club has spent a considerable amount of time visiting primary and secondary schools and exhibiting their race cars at museums and environmental festivals. Even though they distract a bit from R&D, the educational ventures have become an integral part of the club's activities. In addition to spreading the word on the environmental advantages of solar energy, the club members are trying to show kids the pleasures of technology. And not surprisingly, they are usually a big hit wherever they go. The cars look futuristic enough to prompt questions such as: Can it fly? Or break the sound barrier? Sometimes the team members help the children assemble their own miniature solar cars, using toy parts, solar cells, screws, and wire.

On the racing front, MIT's entry, *Solectria 5*, came in second in the Solar and Electric 500 in Phoenix, Ariz., last April, in spite of going through the world's "first solar car spinout" when a rear tire blew out. Second prize was supposed to be $10,000—but unfortunately the race organizers went bankrupt and have been unable to deliver more than a small percentage of the prize thus far. Similarly, in May's American Tour de Sol from Albany, N.Y., to Plymouth, Mass., the race car *MIT 5X* came in first for the third year in a row. But there was no prize money for the racing class. Such are the disappointments of technological pioneering.

With a lift provided by Lufthansa for car (free) and crew (half fare), *MIT 5X* next journeyed to Europe in June for the Swiss Tour de Sol, the largest solar and electric vehicle race in the world. Here steep downhills caused an axle failure, forcing the kind of inventive scramble for which the Solar Electric Vehicle Club is known. They found a friendly farmer who happened to have a machine shop and some aluminum. Working from midnight to 9 am, the crew fashioned a new axle and proceeded to take second place, worth $2,000—which they did receive.

Along with developing the Aztec, the club is concentrating on ever-lighter weight—both of construction materials and batteries, the ever-present need to fundraise, and nailing down the nitty gritty of running an organization. It seems that Worden, the founding father of the club, had details like how to get a solar car out of customs or dealing with the Registry of Motor Vehicles stored in his head, so his heirs have to learn them anew. This time, the information will be documented, so the students can get on with their real passion—refining solar energy. □



Peter Rexer, '92, the driver of MIT 5X, *glides across the finish line at the end of the fifth of six stages in last July's Swiss Tour de Sol. The town is Thun, in central Switzerland. The car finished second overall.*

PHOTO: PAUL DUCHNOWSKI

With three years of growing success behind it, the Parents' Program's Family Weekend may now be designated an MIT tradition. Sponsored by the Alumni/ae Association and held October 18 and 19, the event brought nearly 600 families to campus from all over the United States, as well as Korea, Belgium, and Japan.

K-12 Council Formed

The Institute's commitment to addressing scientific illiteracy in the nation is gathering pace—and cohesion. In September, Provost Mark Wrighton announced the establishment of a Council on Primary and Secondary Education to coordinate and expand the efforts of the MIT community to enhance science teaching and learning in kindergarten through grade 12.

The council, to be headed by Professor of Materials Science and Engineering Ronald Latanision, is one outgrowth of last year's Committee on K–12 Education, formed to explore the question of whether MIT should develop an institutional role after years of work by individuals and small, independent groups. That committee was also chaired by Latanision, who served as director of the School of Engineering's Materials Processing Center from 1984-91 and founded MIT's Science and Engineering Program for High School Teachers *(see page MIT 5, November/December 1991).*

The council will consist of 15 members, including faculty, staff, undergraduates, and graduate students, who will serve three-year terms. One of its aims is to use the media to bring about change in the public attitude toward science and math, according to Latanision. The "hook," he says, "is the personal standard of living of the typical American—the technology-based economy of the 21st century will not absorb workers who are not science literate."

There are currently some 40 outreach programs in various departments at MIT that have been developed over the years. They range from the week-long summer program run by Latanision to school visits by MIT students to demonstrate their science or engineering disciplines, to tutorial projects. Until now, there was no structure to pull those programs together—or to explore new initiatives. □

Alpha Phi Finds a Home

The February/March 1984 issue of *Technology Review*, in reporting the achievement of official "chapter" status of MIT's first social sorority, mentioned that "the search for a house—and financing to purchase it—continues." Seven long years later, Alpha Phi's dream of a home of its own has finally been realized. Fifty-seven Alpha Phi members and a house director moved into two connected brownstones on Commonwealth Avenue in Kenmore Square at the beginning of the first semester.

The house, which was bought for $2.4 million, is owned by MIT and leased to the sorority. The $1.4 million in renovations were paid for by the local alumnae group, the Zeta Phi Chapter House Corp. of Alpha Phi International Fraternity, Inc., which took out a loan for that amount from the Institute's Independent Residence Development Fund (IRDF). The loan will be repaid over 40 years on a three-percent schedule. Each student pays $2,400 per term for room, board, laundry, utilities, and "paying off our mortgage," according to APhi President Christina Kwon, '92. That is less than the cost of living on-campus, but higher than that of other independent living groups. But it is hoped that the cost will come down. Kwon was enthusiastic about the increased sense of unity a house brought to the sorority, which more than compensated for the extra work involved in running its own residence.

The biggest challenge in renovating the structure turned out to be how to create a "house" atmosphere for 60 people. Both the architect and the construction company were headed by MIT alumni, and dozens of members of the MIT community worked to realize the project. The zoning and licensing alone took more than a year.

In addition to assorted rooms for one to four students, the sorority house has a kitchen (and a cook), a dining area, parlor, television room, study, chapter room, and roof deck. It is also wired for an Ethernet link, allowing the women to connect their personal computers to Athena.

Whether another of the four sororities at MIT can follow in Alpha Phi's footsteps depends in large part on a similarly fortuitous confluence of events and opportunities, according to Stephen Immerman, director of special services in the Office of the Senior Vice President and a key figure in the housing quest. (All but one of the 27 fraternities have their own houses.) A reasonably priced property in good shape, in an accessible neighborhood, under favorable zoning requirements, without other interested buyers, etc., will not be easy to come by. But should such a property materialize, the IRDF could make the difference. Created by alumni/ae contributions, the fund is able to replenish itself through new gifts, loan paybacks, and the interest on unloaned funds. □

PHOTOS: ELIZABETH HAMLIN

ALUM
NEWS

Alumni/ae Volunteers Informed & Honored

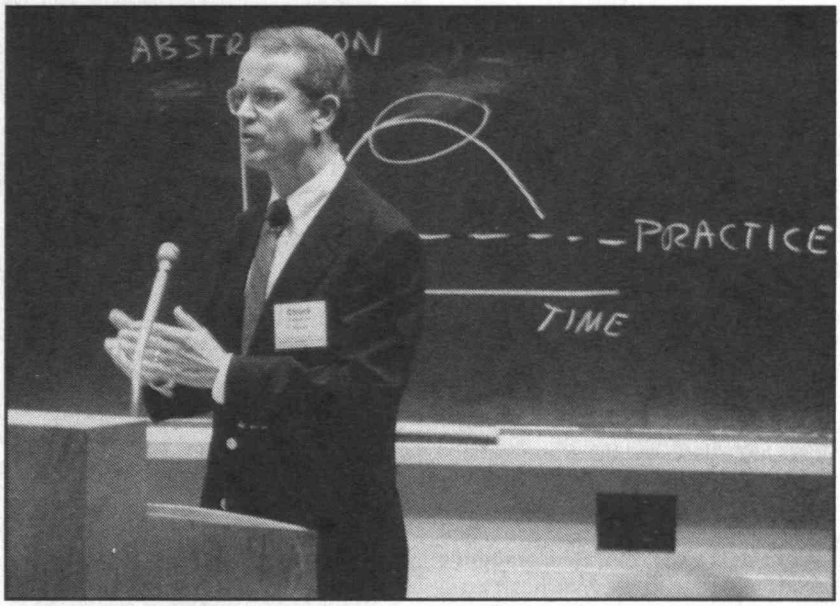
Maintaining MIT's position as the world's premiere institute for science and technology was the subject of discussion at the annual Alumni/ae Leadership Conference, held in late September. Active alumni/ae volunteers from around the country attended the meeting to hear from top administrators about issues on the MIT agenda.

Topics were as broad as the problems facing education in the 1990's and as specific as a look at Institute financial resources. The emphasis at the two-day conference was on increasing alumni/ae participation, not only in terms of financial support, but also a sharing of their professional acumen, contacts, and vision.

Association President Peter Saint Germain, '48, opened the day with a summary of recent activities, emphasizing the Association's role in the final year of the *Campaign for the future* and its drive to the $700 million goal. Saint Germain provided the perfect lead-in for Alumni Fund Board Chair Karen Mathiasen, SM '71, who updated listeners on FY 1992 fund performance to date. As of early September, giving was down slightly from the record in 1990—a decrease attributed to a slow economy. The fund board has set a goal of $16.5 million for the year ending June 30, 1992, an increase of $1.4 million over 1991.

The Alumni Fund Board hopes that Project 2000—a special fund for classroom renovation—will help bring the goal within grasp. The philosophy behind Project 2000, in a nutshell, is that nostalgia has its place. Fundraisers are banking on the notion that alumni/ae will enthusiastically support the updating of classrooms that may have remained essentially unchanged since MIT moved to Cambridge in 1916. No tears are expected over the provision of smaller, well-furnished rooms to enhance teacher-student interactions, the reconfiguration of lecture halls to match class sizes, improved lighting and acoustics, up-to-date facilities for demonstrations, and enhanced power supplies to accommodate classroom use of computers.

But while donations support the new, the reward for donors is a piece of the old. Contributors of at least $500 to Project 2000 will receive a palm-sized chunk of the original granite steps at 77 Massachusetts Avenue—kept in storage since the steps were repaired in the 1970s—mounted a walnut block and suitably inscribed. "We have a whole warehouse in East Cambridge filled with these," said Mathiesen, holding up a "piece of the steps" and making it clear she would like to see numbers of donors to match the supply of mementos.



President Charles Vest addressed the Alumni/ae Leadership Conference.

In his remarks, President Charles Vest noted that this was his second appearance at an ALC, and observed that "Since coming to MIT, I have been reminded of the old Chinese curse, 'May you be born in interesting times.' And in the sense that the word interesting is used in that saying, these are interesting times at American research universities."

Referring to recent questions about universities' handling of academic fraud, indirect research costs, and financial aid, Vest said that the biggest challenge "is to listen carefully to what our critics have to say and see if they're valid." Highly publicized overcharges on some bills for federally funded research has placed the universities in a particularly sensitive position, triggering what Vest described as a "feeding frenzy, as people look into every nook and cranny to see if $3 or $4 million in charges have been miscoded." MIT must maintain a commitment to the careful stewardship of public funds, the president said, adding that this responsibility will be easier to fulfill if the system for billing for indirect costs is simplified and standardized by the federal government.

Vest described how MIT is addressing the United States' social and economic issues head on, through programs like the Commission on Productivity, the Leaders for Manufacturing Program, and the Council on the Global Climate. These programs, which draw together people from management, engineering, economics, and social sciences, represent a new, interdisciplinary approach to problem-solving that Vest says will ultimately transform not only research, but the whole teaching process.

Next at the ALC keynote session, Provost Mark Wrighton shared with participants his enthusiasm for the new Faculty Fellows Program, which consists of financial awards to teachers who have made "exemplary and sustained contributions to the teaching and education of undergraduates at MIT." He emphasized the need to increase the Institute's financial resources and urged alumni/ae to work with MIT to build the endowment, which is essential if the Institute is to sustain its need-blind admissions policy.

The ALC program then shifted to a panel consisting of Dean of Engineering Joel Moses, PhD '67, Dean

of Science Robert Birgeneau, and Dean of Humanities and Social Sciences Philip Khoury. It was their job, in essence, to remind alumni/ae why volunteers would want to work as hard as they do on behalf of MIT.

Joel Moses announced that several departments within the School of Engineering are developing plans for a master's degree as the first professional degree, following enriched bachelor's programs that give students very strong grounding in the fundamentals. (The departments will continue to offer the traditional master's, which is an intermediate research degree.)

Moses also discussed the school's plans to organize flexible, interdisciplinary project teams, which will help MIT respond to changing research goals in an era when shrinking dollars and limited academic real estate make it extremely difficult to establish new laboratories and research centers. The teams would be assembled to develop new research opportunities, then disbanded as soon as their work was complete, freeing personnel and resources for other projects.

Robert Birgeneau discussed the new core subject in molecular biology, which will be required for students beginning with the freshman class entering in 1993. He spoke of the revolution taking place in biological sciences and explained that the school was trying to return to "a more tactile education, slightly less theoretical." This means more take-home experiments for first-year science students.

And as Philip Khoury explained it for alumni/ae, "What makes the humanities different at MIT is the desire to make intellectual bridges to engineering and science. Humanities can help scientists and engineers understand institutions and how they operate," he said. Khoury anticipates increased collaboration among humanists and scientists and engineers, especially in areas of global climate change, environmental studies, telecommunications, and the world economy.

Next, Senior Vice-President William Dickson, '56, tackled the oft-heard question, "With all that endowment, why aren't we rich?" in his talk on the finances of the Institute. MIT has approximately $1.4 billion invested in endowed funds, but the important figure for any school is not absolute dollars, Dickson explained, but endowment in relation to the size of

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All photos left to right:

1 ***Bronze Beaver award recipients: Wendyl Reis, DuWayne Peterson, Karen Mathiasen, James Levitan, Bonny Kellermann, and Bradford Bates.***

2 ***The recipients of Lobdell Awards: John Brown, Edward Thompson, Albert Bottoms, William Maini, Philip Sayre, Allan Mowatt, and Milton Royce.***

3 ***Morgan Awards were presented to educational counsellors John Morefield, Michael Goldman, and James Neighbors.***

4 ***Ernest Cohen and Stanley Rose received Kane Awards for 1991.***

5 ***On hand to accept Presidential Citations on behalf of their organizations were: Robert Mann, '50, for the Class of 1950 Student Aid Fund; Horace Homer, '38, for the MIT Club of Cape Cod; Hyun-A Paek, '83, for the young Alumni Steering Committee of Boston; Panos Spiliakos, '60, for the MIT Club of Boston; and Alan Cisar, '73, and Marilyn Cisar, '76, for the MIT Club of South Texas.***

PHOTOS: BARRY HETHERINGTON

the institution. Endowment dollars per per faculty member, for example, is a standard measure for comparing one university with another, and on that scale, Princeton's endowment is 160 percent larger than MIT's, Yale's is more than 100 percent larger, and Harvard's is 60 percent larger.

After a morning spent raising information levels and firing up the troops, the ALC luncheon was an occasion for honoring volunteers whose past performance helped put MIT in its present strong position.

The highest accolade the Association has to offer is always the Bronze Beaver, awarded in recognition of distinguished service to the Institute and the Alumni/ae Association. Fewer than 200 alumni/ae have been so honored since the award was initiated in 1955. This year the names of Bradford Bates, '59, Bonny Kellermann, '72, James Levitan, '45, Karen Mathiasen, SM '71, DuWayne Peterson, Jr., '55, and Wendyl Reis, '56 were added to the roster.

•Bradford Bates has served as the linchpin of all MIT alumni/ae activities in the Detroit Area for more than 15 years. Before moving to Michigan, he was active in alumni activities in Massachusetts and California, and he has served with distinction on several national committees, including a term on the Association's Board of Directors.

•Bonny Kellermann, known to alumni/ae coast to coast after her 15 years as head of the Educational Council, has also been a leader in the Class of '72, is a director of the MIT Community Service Fund (which channels donations and volunteer efforts to MIT's neighbors), and is president of the Association of MIT Alumnae (AMITA).

•James Levitan first became involved with the MIT Center of New York City as area chair for the Educational Council in the 1970s. He has been active in the center ever since, presently serving as chair of the Executive Committee, and he is a member of the MIT Corporation.

•As a graduate alumna, Karen Mathiasen has put the lie to conventional wisdom about people only being loyal to their undergraduate institution. She has served as president of the MIT Club of Boston, chaired the Technology Day Committee, co-founded the Graduate Management Alumni/ae Association, and currently serves as both chair of the Alumni Fund Board and as vice-president of the Association's Board of Directors.

•Duwayne Peterson is a current member of the Corporation and has served on the Educational Council, the Alumni Fund Board, and the Visiting Committees for both Student Affairs and the Economics Department. He was vice-chair of the National Campaign in New York, served as co-secretary of the Class '55, and was a founding member and now chair of the Sloan School Board of Governors.

•Wendyl Reis has taken a leadership role in the Houston-based MIT Club of South Texas, and has served as a campaign solicitor both locally and nationally. He was member of the Alumni Fund Board and founded and chaired the Houston Enterprise Forum. Reis' leadership on the Committee on the Future of the Enterprise Forum and its 1989 report is a model of exceptional volunteer work.

Harold E. Lobdell '17 Distinguished Service Awards, given in recognition of alumni/ae service of special depth over a sustained period, were awarded to Milton Roye, Jr., '78, John Jarve, Jr.,'78, William Maini, '51, Philip Sayre, '54, Allan Mowatt, '35, Albert Bottoms, SM '62, Edward Thompson, '49, and John Brown, '32.

•Milton Roye was cited as a model regional alumni leader for his work in the greater Detroit area, as well as his imagination and effort as president and reunion gift solicitor of his class and as a member of the AA Board of Directors.

•John Jarve is another activist for the Class of '78, having worked on the class Reunion Gift Committee, while his region enjoyed the fruits of his labors as a volunteer for the MIT Club of Northern California and as chair and solicitor in the Silicon Valley Alumni Fund Visit Program.

•William Maini's activities include member and 1990 chair of the Technology Day Committee and many offices for the Class of '51.

•Philip Sayre has been an officer of the MIT Club of New Haven, the Executive Committee of the Connecticut Enterprise Forum, the Alumni Fund Visit Program, and the National Campaign Committee. He is also a member of the Association Board of Directors.

•Allan Mowatt was honored for more than 20 years as class secretary, work that contributes significantly to the spirit of unity between the Institute and its alumni/ae body.

•Albert Bottoms was recognized in particular for his service to the MIT Clubs of Washington and the Palm Beach Region and the Graduate Alumni/ae Program.

•Edward Thompson has made exceptional contributions as member and chair of the Technology Review Board, and as a member of the Association Board of Directors and Corporation visiting committees.

•John Brown was honored for his dedication and generosity to the Class of '32, the MIT Club of Boston, and the Alumni Fund.

Since 1979, the Education Council has awarded George B. Morgan '20 Awards to counsellors who exhibit exceptional standards of achievement and professionalism—in both their dedication to MIT and their concern for the best interests of prospective students. Honored in 1991 were:

•George Butzow, '51, a counsellor since 1962 and regional chair for the Minneapolis Educational Council.

•Michael Goldman, '52, a counsellor since 1967 and chair of the Phoenix Educational Council.

•Raymond Laub, SM '60, a counsellor for 25 years and regional chair in Milwaukee for 20 years.

•John Morefield, Jr., '56, who joined the council in 1961 and served as chair for the Harrisburg, Pa., area since 1978.

•James Neighbours, '41, a counsellor since 1967 and vice-chair for Suffolk Co., N.Y., since 1973.

Henry B. Kane '24 Awards acknowledge exceptional service and accomplishments in fund raising. This year, the award went to William Brody, '65, Ernest Cohen, '64, and Stanley Rose, '67.

•William Brody was honored for recruiting and chairing an outstanding 25th Reunion Gift Committee for the Class of '65 and leading the class to a $2.3 million gift.

•As a founding member of the Association of Black Alumni/ae of MIT (BAMIT), for many years its treasurer, and now president, Ernest Cohen has led efforts to increase the endowment of the Ronald E. McNair '77 Scholarship Fund, named for

continued on page MIT 42

1943–1991

A Life Spent Forging Links in the Chain

By Debra Cash

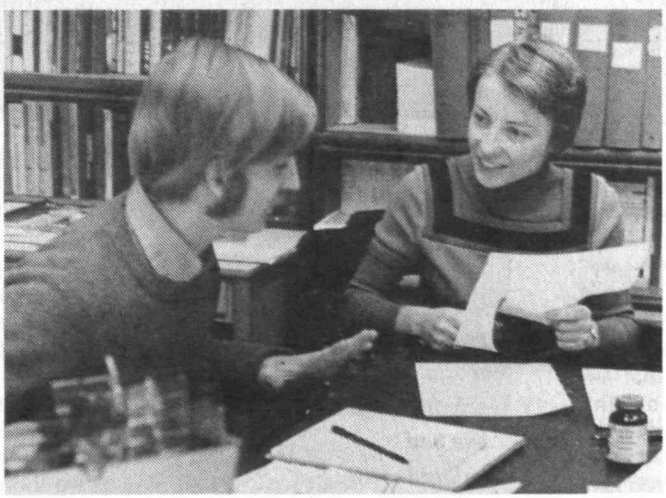
On September 30, Margaret MacVicar, '65, PhD '67, Cecil and Ida Green Professor of Education and dean for undergraduate education, died of cancer. For more than a year, she had fought the disease, continuing her work between bouts of chemotherapy.

A physical scientist whose place in MIT history was assured when she founded the Undergraduate Research Opportunities Program (UROP) at age 26, MacVicar was, in her post as dean, a leader in the effort to revitalize undergraduate education and make it the touchstone of the Institute.

MIT was her intellectual base for her entire adult life, a life marked by exceptional opportunities as well as exceptional ability. And she was convinced that the best elements of her own experience could be built into educational structures and made available to many young people, at MIT and elsewhere. "Margaret received a lot of help along the way and felt she should pass along that help," says her sister Victoria. "She felt that you can never give something back to the people who helped you, but you can turn around and give to someone else. She felt that she was part of a long chain."

The chain was anchored in the rock-solid, midwestern values of her childhood. She grew up in Flint, Michigan, the eldest daughter of a General Motors plant foreman. Her mother worked as assistant to the manager of the Flint airport. As MacVicar's closest research colleague, Judith Bostock, would later recall, her mother was, and is, a woman whose limited formal education was more than made up for by "great innate intelligence. She was one of the major pillars of Margaret's life," Bostock says. "Her opinion was always the most important one."

There were no scientists in the MacVicar family, but when *Sputnik* was launched in 1957, Margaret was chosen for a special science curriculum established—virtually overnight—at Whittier Junior High. "It was all new territory," Victoria recalls. "From seventh grade on, she was interested in science." Margaret started to win prizes at science fairs, and her awards were publicized in the local newspapers.



From her days as a young lecturer in physics, Margaret MacVicar's weekly meetings with her students "had the atmosphere of conspiracy," remembers James Bellingham, with students invited to pull their chairs close to her desk and argue points of disagreement like colleagues.

By her third year in high school, she was taking science courses at a local junior college, and her selection as one of only two female students in an intensive summer science course at the General Motors Institute was a pivotal experience. Bostock, now chief operating officer of the South Carolina Universities Research and Educational Foundation, says Margaret discovered at GMI that "if you do first rate work, it will carry. I think that's where her disciplined work habits came from. It was a difficult course, but she loved every minute of it."

Academically, there was no question that Margaret was college-bound. But where would she find the money? The answer came from an unlikely source, a man MacVicar would refer to later as her "fairy tale" benefactor. Robert Longway, a retired General Motors executive and banker turned philanthropist, had read about her achievements. He arranged to meet with her, and offered to pay the difference between what she had and what she needed to attend MIT.

With Longway's help, she enrolled in 1961, one of 25 women in a class of just over 900 students. MIT was ambivalent about the presence of women; only a year before, a faculty committee had recommended that women not be enrolled, but the move was rejected by President Julius Stratton, '23. Vestiges of discrimination remained, but MacVicar thrived in the MIT environment nonetheless.

"Jerrold Zacharias was impressed with her as a freshman because she asked all the right questions," recalls Professor Emeritus of Physics Albert Hill. Indeed, the guidance and friendship of Zacharias, one of MIT's most distinguished physicists, was another pivotal element in Margaret's life.

"Zacharias suggested that we have a seminar with a mix of undergrads, graduate students, and faculty," Hill says. "We discussed affairs of state, physics—you name it. The only protocol was knowing the topic for next time. We met in the evenings for two to four hours, and there was no credit. Margaret enforced equal rights before they became law; she didn't pay any attention to the fact that she was one of the few women."

Rainer Weiss, '55, a graduate student in Zacharias' lab at the time and now a professor of physics at MIT, remembers that during one of those evening meetings, he and MacVicar had an argument about the Doppler effect. "We had a question about the change in the pitch from a moving source and were trying to figure out where the energy went. I don't know who was right. But both of us realized that she was able to think on her feet. As a freshman or sophomore, this gal had more on the ball in terms of being able to express her ideas, and was far more mature in her thoughts, than the average undergraduate."

Weiss, too, remembers the close—and contentious—relationship that "Scotty" MacVicar had with Zacharias. "Jerrold was very fond of her," he says. "She was zippy. She could do several things well. The most important thing was that Jerrold spoke in parables. He was a delightful man, but he had learned over the years that to win an argument you don't go directly to the point. Instead you give someone a puzzle to think about and that person will eventually see the relevance of the puzzle. Scotty was very good at understanding that, and she was able to follow him."

To minimize the cost to her benefactor, MacVicar hustled through the undergraduate degree in three years and then went on to earn a doctorate in metallurgy and materials science in 1967. After going from Cambridge, Mass., to Cambridge, England, for her postdoctoral year, she returned in 1968 to a country and an Institute strained by demands for change. Unrest over civil rights and Vietnam were compounded by local concerns: Undergraduates were effectively isolated from the research activities that gave MIT its focus and prestige, and the curriculum had been largely unchanged since shortly after World War II.

President Jerome Wiesner and Chancellor Paul Gray, '54 assembled what MacVicar later referred to as a loose "rump cabinet" to think about these issues. Now that MacVicar was a junior faculty member, Zacharias started bringing his protege along to these meetings, where the estrangement of students and faculty was a major topic. "At MIT, like other places, students are intimidated by professors and don't want to harrass them after class or see what's going in their labs," explains Kenneth Brecher, '65, an astrophysicist who was a classmate and then a young faculty colleague of MacVicar's. The summer of his freshman year, Brecher, now a professor at Boston University, got a toe in the door in a reseach lab by agreeing to do the menial chores. "After that I got credit for it or worked for pay, but you had to have a certain amount of chutzpah to walk in."

MacVicar set out to give her students the same access to the entire professional world of the scientist that she had enjoyed with her own mentor, Jerrold Zacharias (right). Shown with her graduate students in June 1988 (from left) Richardo Jaimes, Margaret, Thomas Altshuler, Elenna Dugundji, Bruce Jette, Chun The, Scott Lordi, James Bellingham, and Mira Misra.

Rainer Weiss agrees. "Many of us in the labs would take undergraduates, but it was always impromptu. There was no formal way of paying them or giving them credit. I remember talking to Margaret about the fact that the single most attractive thing about a big technical place like MIT was its research opportunities, but that I was horrified at the idea of systematizing such an apprentice system and alarmed at the bureacracy that might come with it."

But when Paul Gray suggested that she attempt to formalize the best of those apprenticeships, MacVicar didn't hesitate. In 1969, with the interest from a $4 million endowment fund established by Polaroid's Edwin Land, she launched UROP.

"UROP was Margaret's invention," says Albert Hill. "What made her stand out from the mob was that she didn't just *say* we should do something, she *did* it. What professors complain about is that teaching undergrads takes time from their illustrious research. UROP gave them a chance to do their research and teach at the same time." MacVicar and her staff developed a directory listing faculty members and their fields of expertise, established guidelines for students to receive academic credit or be paid, and began the intellectual matchmaking.

UROP is, in the opinion of Paul Gray, "the most important and influential educational development in this half century," and MacVicar put it together, he said, in the face of "massive conservative forces in the Institute in 1969, informed by the opinion that UROP . . . did not deserve to succeed."

At first, UROP seemed marginal, very

PHOTOS: FAMILY, FRIENDS, AND THE MIT MUSEUM

much an "alternative" program. Norma MacGavern, hired by MacVicar in 1976 to help administer UROP, recalls, "We had a tiny, shabby office in the outpost of Building 20, and we were proud of how much we did on so little."

MacVicar understood that UROP's success depended both on a solid intellectual footing and on administrative vigilance. Benson Snyder, a psychiatrist in the MIT Medical Service who later held a variety of administrative posts serving undergraduates, relates, "If there was a student not working [up to expectation], Margaret would find out what the story was in a day or two. And if she thought a faculty member was using a UROP student as cheap labor, she'd tell that person he couldn't have any more UROP students. Everyone took it increasingly seriously.

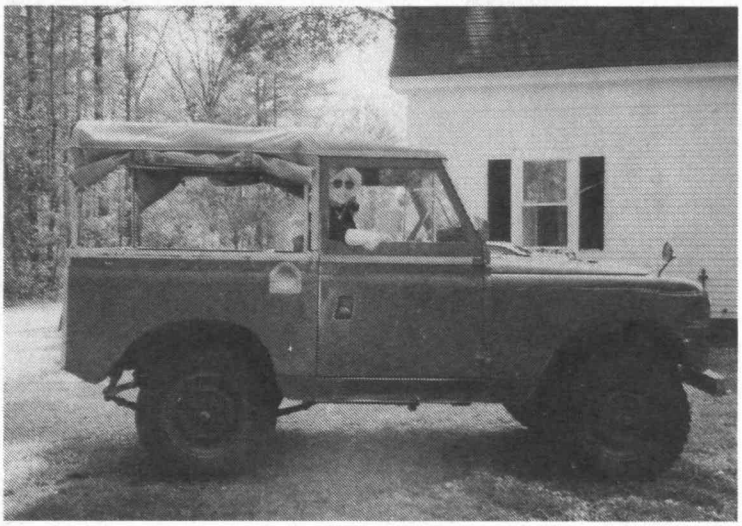
"It's rare to see educational accountability in real time, something that's more responsive than the reports people write up at the end of the year," says Snyder, who first met MacVicar while working on his book, *The Hidden Curriculum*, a study of the class of '65. "Margaret was able to get feedback and fix anything that was in trouble. It was interesting that after the first two years of UROP, some administrators suggested that each department [manage its own UROP effort], but when they went to the departments, the faculty said 'don't you touch it.' "

UROP, over the course of its first decade, became the paradigm for the creative integration of education and research. "Being an undergrad at MIT had been a wonderful experience for Margaret," observed her McCormick Hall roommate and longtime friend Edie Goldenberg, '67, now dean of the College of Literature, Science, and the Arts at the University of Michigan. "Margaret was convinced that the people MIT recruits as first-year students are extraordinarily talented. She was determined to make their experience at MIT worthy of the students."

But UROP was just one program—its success did not complete her whole agenda. "Margaret and I were involved in the Experimental Studies Group (ESG), where freshmen can elect self-paced, independent study, back in 1969," says J. Kim Vandiver, PhD '75, professor of ocean engineering and current chair of the MIT faculty. "She was always thinking creatively about what the undergrad experience could be. She wasn't willing to let things remain business-as-usual."

When John Deutch, '61, became provost in 1985, he named her dean for undergraduate education. "This was the last time this century we were going to review the undergraduate curriculum," he explained, "and Margaret was exactly the right person because of her enormous energy, the nationally recognized success of UROP, and her complete dedication to education."

But the title didn't make her job easy. "At first, she was a dean without portfolio and had to carve out her own territory," points out Vandiver. When asked by a *Tech Talk* interviewer whether, as dean, she was in a position to lead MIT's curricular reform efforts, she answered with characteristic good humor. "One doesn't lead a federation of royal barons and tribal chieftans. Cajole, yes. Remind, yes. Persist, yes." But in the same interview, she went on to say, "It is timely for MIT to think through its objectives for the future. For choices have to be made. A choice between continued specialization and the technical density of our leading undergraduate programs, and a broader, more fundamental integration of technical with humanistic studies." Regarding specialization, she believed, the pendulum had swung too far.



As a new postdoctoral fellow, Margaret MacVicar paid a call on John Longway (right), the Michigan philanthropist who offered to pay her way to attend MIT. Longway's generosity launched a rich career whose fruits included Margaret's beloved old Land Rover and her farm in West Lebanon, Maine (above).

"Another choice [that] may surprise you," she said "[is] between continued unchecked growth in research volume—to which increasing graduate student, postdoctoral, and research staff numbers are tied—and reserved time and attention to our undergraduates."

Judith Bostock says MacVicar had turned her thoughts toward how shared experiences create a sense of community. "The undergraduate core program provides the centripetal force that holds the MIT faculty together and is the ethos of our common meeting ground," Margaret once wrote.

Some of the changes she effected were subtle. For instance, MacVicar discovered that solving physics problems assigned *early* in first semester requires mathematics that wasn't introduced in freshman calculus until the *end* of the semester. And it was addressed—when she arranged for teachers of the core physics and math subjects to sit down together. Other changes, like the restructuring of the humanities options and the creation of a biology requirement, were dramatic.

"No one on campus seriously believes that there is just one correct curricular path

path to serve the needs of all students for the foreseeable future," MacVicar wrote in 1987. "The power and significance is in the debate itself, for here is where perspectives, attitudes, and culture are shifted."

No matter what her administrative commitments, MacVicar never phased out her teaching and research. "Margaret was a physical scientist," Bostock explains. "Physicists are interested in theory and the properties of certain phenomena. Materials scientists are interested in how materials form and behave. Margaret had a foot in each camp."

Robert Rose, '58, professor of materials science and engineering and MacVicar'sdoctoral thesis advisor and collaborator, said that "in all of her research, difficult but significant questions were attacked with great tenacity."

The focus of her research was superconductivity, and she was the first to achieve electron tunneling into single crystals of several transition metal superconductors. These experiments led to a re-examination of the strong coupling theory of superconductivity. Her later work dealt with the detection and characterization of corrosion, and in 1987, a team working under MacVicar made a breakthrough in non-invasive corrosion testing with a Superconducting Quantum Interference Device magnetometer.

As a teacher, students recall, MacVicar was demanding and willing to take risks. According to Noah Mendelson, '74, who worked in MacVicar's lab on a UROP project for nine months, "When a freshman walked in and said 'I want to do this' her first reaction would be 'great'; her second was [to ascertain if] that person was qualified—and she'd be hoping the answer was yes. Nothing made her happier than undergrads rising to a level competitive with the grad students. She was clear that if you wanted to join her lab, you joined as an equal. The opportunities were very great and the standards very high."

Bruce Jette, one of four doctoral candidates working with MacVicar at the time of her death, says that she had a unique way of dealing with her graduate students as well. "She wanted us to be not just scientifically competent, but to understand the scientific profession, to know where the money comes from, how you fulfil your sponsors' desires, how you keep track of technology and trends.

"You couldn't ask her a question without leaving her office with a stack of books and articles she thought you should read," Jette said. "She wanted you to be able to act independently. And she'd often say 'go into the lab and play.' She thought it was important to explore things that you weren't ready to put on paper."

When MacVicar called on her students to present their results, says Jette, she was "as thorough as an adversarial peer-review process. She didn't want you learning to defend your work standing on a platform at a conference." The first time a student went through that process "was really uncomfortable! But she wanted us to be able to tell good work from bad work."

MacVicar relished the travel that her work often entailed, starting with her post-doctoral post in Cambridge, England (right), and including a trip to the Alaskan oil fields as a member of the Board of Directors at Exxon (above).

As and administrator, teacher, researcher, and later, member of a number of boards and national committees, MacVicar's career was a whirlwind. Her personal calendar was made up three months in advance. Yet in the margins of those calendar pages were checkmarks, and to initiates in her office, the checks meant Margaret was going to Maine.

It was a place of retreat. Her farm in West Lebanon had a grape arbor and a garden with an asparagus bed. She chopped her own firewood, and if the roof needed repair, she did it herself. She held her friends in Maine in high regard. "She believed in dealing with people as people regardless of their station in life," her friend Edie Goldenberg recalls. "If you look at her friends, they represent an enormous range in terms of what they do, what sort of careers they pursue, how well off they are." At town meeting, at church, when stopping by for hot chocolate, her Maine neighbors gave MacVicar a sense of being at home.

Her passion for methodical planning came in handy when she had to be in two places at the same time. Louise Harrigan, who worked as MacVicar's secretary for almost 10 years, remembers the time that Margaret rushed up to Maine to clean her well, dug out the muck, added disinfectant, and then after a shower and a change of clothes, took a plane from Portland to a meeting of the Exxon board of directors in New York without missing a beat.

Jess Hay, an Exxon director who is chairman and CEO of Lomas Financial Corp. in Dallas, recalled MacVicar as "a tremendously bright and broad person who brought a perspective on the environment and major social concerns to the board." As chair of the board's audit committee, Hay reports, she was as respected for her no-nonsense

financial judgments as for her scientific expertise.

Different skills came into play during her tenure as vice-president of the Carnegie Institution from 1983–87. James Ebert, Carnegie's president, had met her 20 years before and in the early 1980s had invited her to join a committee of the National Research Council that focused on the state of primary and secondary education. It was a topic she was passionate about, believing, as she wrote, that "the crisis in science education poses a vital threat to our national security, and we should respond much as we would if the threat were military."

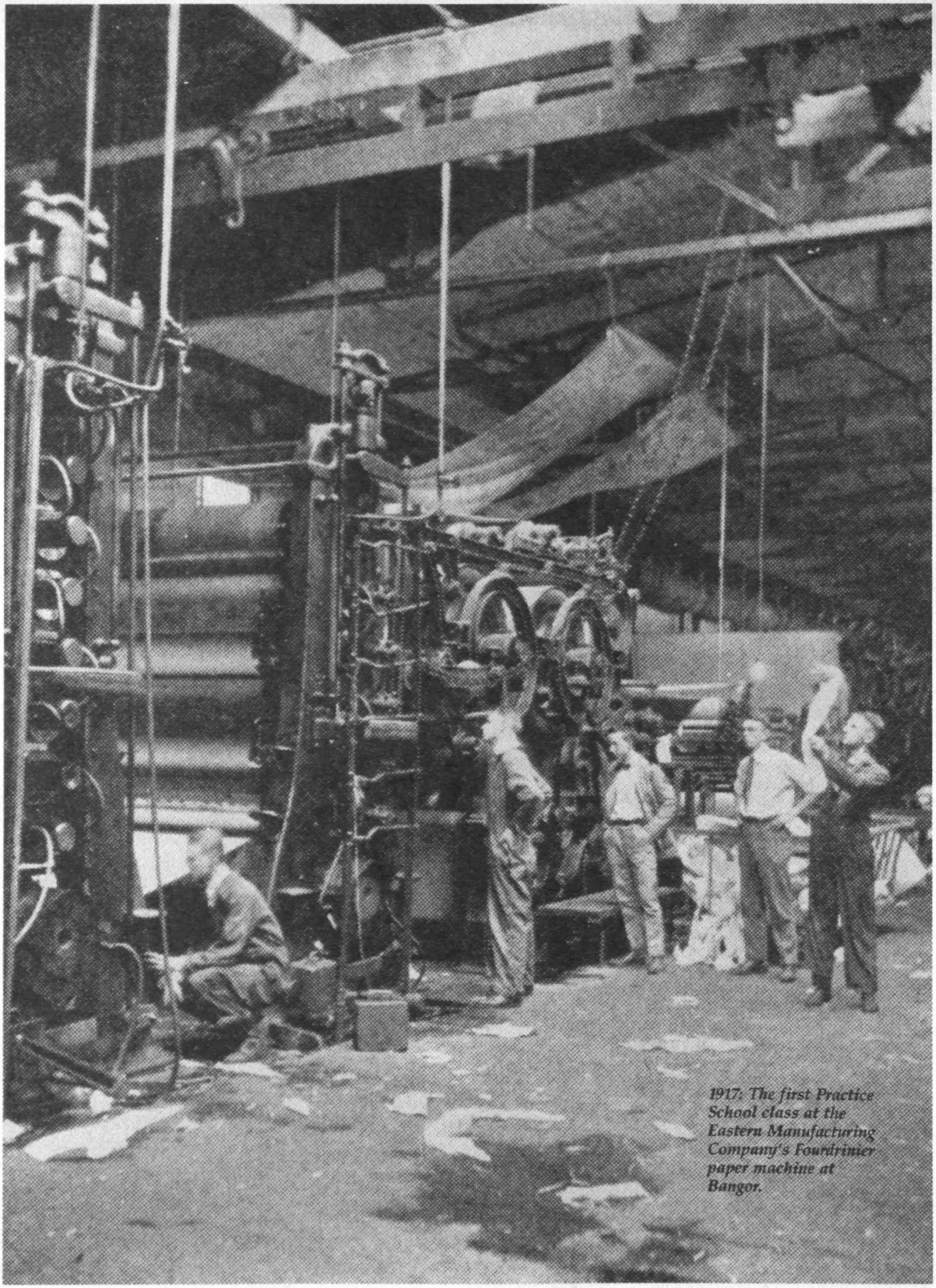
Ebert thought of MacVicar again when he decided to name a new vice-president at Carnegie. "Margaret was gifted in bringing people together," he says. She fulfilled his expectations when she planned the strategy that brought Carnegie's geophysical laboratory and its department of terrestrial magnetism under one roof in Washington, D.C.

She had a knack for seeing what different people needed, and a gift for helping them get it. Undergraduates needed to experience research, and administrators ways to work together. Doctoral candidates needed books, and her neighbors in Maine new air conditioning. "She was extremely generous," points out Louise Harrigan. "If something was due her, she could fight you over a nickel, but she liked to do things for people directly. There was an old man in Maine who had retired from the merchant marine on a small pension, and she'd have him paint a bookcase for her so that he could earn a little extra money. She set up a small scholarship for kids from her high school in Flint in the name of Mr. Longway, who had helped her. And once, she wanted me to see the new Exxon Building in New York City, so we went down, stayed in a fancy hotel, and had dinner at Rockefeller Center."

To MacVicar, the details mattered. "One of the things that struck me was the time she spent preparing to announce the names of graduates at commencement," Goldenberg remembers. "She asked people to send in phonetic spellings of their names, so she could call them out correctly. As she went through the thousand names, she'd pick up the phone and call a few to make sure she had them right. She did it last May, even when she was ill. I've never known another administrator to do something like that, but Margaret believed in rituals. Commencement was the summation of four years at MIT, and she thought how awful it would be for students to have their names mispronounced. And of course, she was right."

MacVicar's life exemplified both the lucky breaks and the hard work it took to transform a young girl's natural talents into public achievements. Margaret MacVicar wasn't willing to leave such accomplishments to chance. Her legacy lies in the trouble she took to create an environment for a new generation of MIT students where their gifts could be nurtured and their voices heard. □

Contributions in Margaret's memory may be sent to a fund to endow UROP. The address is UROP, Room 20B-140, Cambridge, Mass. 02139.



1917: The first Practice School class at the Eastern Manufacturing Company's Fourdrinier paper machine at Bangor.

PHOTOS: MIT MUSEUM

The Practice School at 75

Education on the Factory Floor

By John I. Mattill

Some 15 percent of its living alumni and alumnae came back to Cambridge last fall to help the David H. Koch School of Chemical Engineering Practice celebrate its 75th birthday. By their presence and their words, they gave enthusiastic testimony to the school's success in its first three quarters of a century. And Professor Robert A. Brown, head of the Department of Chemical Engineering, assured them that in its next 75 years the school will be even more relevant to the country's technological problems and more valuable as professional preparation for the students.

David H. Koch, '62, executive vice-president of Koch Industries, whose major gift in 1990 completed an $8 million endowment to provide fellowships, recalls the Practice School as "a fantastic experience—enormously educational." Now, some 30 years later, the Practice School is still offering that level of opportunity, described by Edward P. Browne, SM '91, as "challenging, frustrating, exhausting, exhilarating, grueling, . . . and ultimately satisfying."

It was in 1916 that William H. Walker, professor of industrial chemistry, and Arthur D. Little, Class of 1885 and chair of the Visiting Committee to the Department of Chemistry and Chemical Engineering, proposed forming a school for industrial practice. Elated by the Visiting Committee's instant approval, Little asked George Eastman, president of Eastman Kodak Co., for $300,000 to launch the new program. Eastman (the "Mr. Smith" whose anonymous gifts were already funding MIT's new Cambridge campus) sent the money almost at once, and by 1917 the Practice School was open.

John Mattill, editor emeritus of Technology Review, *is the author of* The Flagship, *a history of the School of Chemical Engineering Practice published by the Department of Chemical Engineering.*

In-House R&D, Student-Style

Little's plan was for an aggressive MIT outreach to the country's fledgling chemical industry, which was then undergoing spectacular growth and development in the same way that communications and computer science did after World War II. MIT would establish "stations"—actually small laboratories—at several chemical companies, each station under the direction of a member of the faculty. Roughly half of a master's degree program in chemical engineering practice would consist of rotating through all the stations, working on chemical problems encountered by the host companies, under the supervision of resident MIT faculty.

From the students' point of view, these industrial plants became their laboratories, where making a profit was an essential criterion for success and chemical engineering was practiced on a scale impossible in an academic environment. For the participating companies, the MIT stations functioned like research and development departments, with the faculty serving as research directors who could draw on their Cambridge colleagues for additional expertise.

The David H. Koch School of Chemical Engineering Practice remains basically unchanged in concept after 75 years and some 2,400 students. Students and faculty still work and learn together by solving technical problems for large, diverse chemical companies.

It is the "flagship" educational program of MIT's Department of Chemical Engineering, unique in the United States and copied only in India and Canada, according to Professor T. Alan Hatton, director.

The 300 former Practice School students and staff who returned for the 75th anniversary celebration clearly recall how they were driven by complex problems, short deadlines, and long hours of intense work. They described being immensely stimulated by the large systems on which they worked and quickly gaining confi-

Participants in the Practice School's 75th anniversary symposium might well have found the contacts as fruitful as the formal presentations. In the foreground, Robert Brown (left), head of the Department of Chemical Engineering, talks to Jean Leinroth, PhD '63, of Leinroth Assoc. in Connecticut. Just behind them, David Koch, '62 (left), of Koch Industries, confers with Jefferson Tester, PhD '71, director of the MIT Energy Laboratory and former director of the Practice School.

dence from their newfound professional status.

"I certainly am proud to have been a part of it," said Earp F. Jennings, SM '39, who is now retired after a career in technical management at Hercules, Inc., where he was once a Practice School student.

In the most hilarious moment of the day-long symposium on the Practice School's past, present, and future, Hoyt C. Hottel, '24, professor emeritus of chemical engineering, performed a reprise of the song he composed to honor a group at the Bethlehem Steel mill in Buffalo, where he was assistant director in 1924-25. The students had made an error of several decimal places in calculating the energy consumption of a chemical process, while they were working on the first stage of a project to increase the company's energy efficiency. In a stanza of doggerel sung to a theme from Wagner's "Parsifal," Hottel celebrated the young engineers' astonishing ability to squeeze energy from a single ton of coal. Enough energy, sang Hottel, "to run the lime kilns of the whole damn country."

Learning "Real Engineering"

Over the Practice School's lifetime, its stations have been sited at 22 different locations in the United States. Notable among them are Eastern Corp. in Bangor, Maine; Merrimac Chemical Co. in Boston; in New York at Bethlehem's Lackawanna steel mill in Buffalo and at General Electric Co. in Albany; Oak Ridge National Laboratory in Oak Ridge, Tenn.; and several companies in New Jersey, including: Hercules Powder Co. in Parlin, American Cyanamid Co. in Bound Brook, and Esso Standard Oil Co. in Bayway. Some 35 graduate students will study at Dow Chemical Co. in Midland, Mich., and Merck and Co. in West Point, Pa., in 1992.

The companies that have hosted MIT stations credit the students and faculty with collectively saving them "millions and millions of dollars," says Professor Jeffrey Feerer, Practice School associate director. No one knows the total, he says, because of proprietary secrecy covering technical operations, which includes much of the students' work.

With a basic endowment in place, the Practice School can look forward to a long and productive future, Robert Brown said in concluding the symposium. The Practice School is perfectly positioned to continue to bridge the gap between academe and the nation's manufacturing industries, as it has been since 1917, he maintained. In fact, now that new developments in fields such as bioscience, polymers, and artificial intelligence applied to chemical processes force chemical engineers to crowd more and more science into the academic curricula, the experience of "real engineering," offered by the Practice School is more valuable than ever. □

PHOTO : BARRY HETHERINGTON

CLASS NOTES

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Sadly I report the passing of another classmate. From **John Holton**'s son-in-law, Robert Soderberg (Sloan Program for senior executives '54), we learn of John's death September 1. John, a dedicated alumnus and member of the Class, regularly took part in the annual mini-reunion of the class as well as the five-year major reunions with his wife Sally.

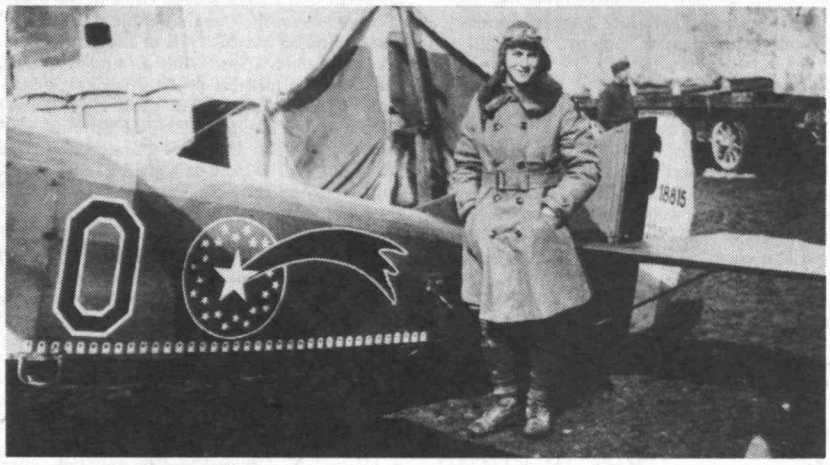
John had a long and distinguished business career with extensive services to community and charitable causes. No one had greater pride in his 1917 affiliation. Bob Soderberg hazards that John's most cherished physical possession may have been his cardinal and gray MIT 1917 blazer, which he would wear on every appropriate occasion.

Following his graduation in chemical engineering, he served during World War I as an army officer in chemical warfare defense. He joined York Heating and Ventilating Corp. in 1927 as director of research. When it and Carrier Engineering merged in 1931 to become today's well-known Carrier Corp., he became director of research operations—later becoming vice-president and works manager.

He was a life member of the Salvation Army, served 27 years on its advisory board and he and Sally were awarded the Silver Tambourine Award in 1977.

John was chairman of the program to build the Syracuse Community General Hospital, was past member of the Syracuse Chamber of Commerce and several professional organizations. He had been trustee of Borodino Methodist Church and chairman of Spafford Zoning Board.

We miss seeing John and Sally and being buoyed up by their enthusiasm. Communications to Sally should be directed through Robert C. Soderberg, Chestnut Circle, Skaneateles, NY 13152.—**Don Severance,** acting secretary, 39 Hampshire Rd., Wellesley, MA 02181



A. Raymond Brooks, '17, was always happy to have his picture taken with a SPAD XIII, one of which now graces the Smithsonian National Air and Space Museum in Washington. Brooks, the last World War I flying ace, died July 17 at age 95. He was 22 when he first climbed into a SPAD biplane in Vaucouleurs, France; in three months time, he had shot down six German planes. He flew 120 missions and was awarded the Distinguished Service Cross and Paris' Silver Medal of the City.

While working at Bell Labs in 1930, he helped develop the first air-to-ground telephone.

One high point of Brooks' life, says Cac Clarke, '21, was being invited by Air France to fly as their guest in the Concorde to the 1981 Paris Air Show. On the trip back, the pilot invited him to sit in the adjacent seat and take the controls. Brooks told Cac that it was the thrill of a lifetime to fly a real giant of the air.

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I had a pleasant telephone conversation with **Eli Berman** who now lives with his wife in a pleasant suburb of Boston at 10 Hackensack Court, Chestnut Hill MA 02169. There are children and grandchildren from his present and earlier marriage to keep him occupied and happy. He had a kidney stone operation within the year—but thank the Lord—he came out well. He is in this area April to November, but spends the winder in California.

I note with sadness the passing of **George Halfacre** of Palmerton, Pa., in August. In addition to a bachelor's degree in mining engineering from MIT, he also received a BS degree from Harvard University in metals and metallurgy. He began his career as a chemist for New Jersey Zinc Co. in Palmerton and worked there for 47 years, retiring as a vice-president in 1965. Some of the other positions he held were manager of manufacturing, general superintendant, and chief of the slab zinc department. He was also the first president of the board of trustees of Palmerton Hospital. He is survived by two sons, a daughter, 12 grandchildren, and 19 great grandchildren.—**Max Seltzer,** secretary, 865 Central Ave., Needham, MA 02192

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You will likely receive mail calling your attention to the special reunion activities planned for certain of the MIT classes for the early part of June 1992. We hope that any of our class who can attend this June will do so but our class will plan for our reunion in June 1994. Hope to see you there.

We regret to report notice from the Alumni/ae Association of the death of **Harold E. Langley** of our class on August 6, 1991, at Epsom Manor, Epsom, N.H. He was born on January 8, 1896, in Durham, N.H., where he attended school and later attended the Haverhill, Mass., High School. After graduating from MIT he was employed by the State of New Hampshire as a bridge engineer until his retirement in 1961. He served in World War I in the United States Army.

He is survived by a son, Harold E. Langley, Jr., of Durham, two grandchildren, four great grandchildren, a nephew and several cousins.

We are also advised by the Alumni/ae Association of the death of Captain **Edward E. Saunders** on April 23, 1991, at age 94. Earlier this year we called him on the telephone and he answered himself with a firm voice. As our talk progressed he told me of his age and the fact that he was blind. His demeanor as we talked impressed me very much. He is survived by his three daughters.

We are pleased to report to you that our classmate **Robert Burns MacMullin** of Lewiston, N.Y., has received a letter from Brigadier General, U.S. Army, Chief of Chemical, that he has been selected for induction into the Chemical Corps Hall of Fame, a rare honor conferred on those who have served the Chemical Corps far beyond the normal call of duty. There will be only 13 members in this elite group. The induction will take place on Honor Day, October 11, 1991.

Francis Weiskittel of our class telephoned me a few days ago to advise he is up and about and doing quite well. Our president, **Donald Way,** and your class secretary have been meeting by phone; he is doing well also.

And now to wish you all the best in life, I remain yours sincerely.—**W.O. Langille,** secretary, P.O. Box 144, Gladstone, NJ 07934

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Andrew Fassit died last year. He lived in Natick with his wife, Julie. He was a professional engineer specializing in refrigeration and air conditioning. He was associated with the Quincy Naval Shipyard, Watertown Arsenal, and Poloroid Corp. He was the youngest to serve on the MIT

PHOTO: SMITHSONIAN INSTITUTION

faculty.

Gerry Tattersfield died early last year. He lived in Philadelphia and was a wool importer. An expert photographer, he traveled around the world several times.

Bill Dewey died at his summer place in Seminole, Fla. He leaves his wife, Barbara, two sons and a daughter, 9 grandchildren and, 10 great grandchildren. He was a mechanical engineer with Anderson-Nichols for 45 years.

Eric Etherington of Los Angeles, Calif., died also. He leaves his wife, Mathilda, a son and a daughter, 8 grandchildren, and 10 great grandchildren.

A welcome letter from **Bink Carleton** indicates his retirement after 40 years in Mississippi in the pesticide industry. His address is 114 Hayes Mill Rd., D215, Dalco, N.J.—**Harold Bugbee,** secretary, 313 Country Club Heights, Woburn, MA 01801

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There is only one item of news this month—that of the death of **Edward W. Hayward** of Braintree, Mass., on August 9, 1991. Your secretary knew Eddie Hayward very well. If I remember correctly, he commuted to MIT from north of Boston. He worked as a chemical engineer for the Monsanto Co. for 30 years.

Our condolences are extended to his family.—**Sumner Hayward,** secretary, Wellspring House E64, Washington Ave. Ext., Albany, NY 12203; **Samuel Lunden,** assistant secretary, 6205 Via Colinita, Rancho Palos Verdes, CA 90274

22 70th Reunion

Another illustrious classmate has passed away. **Edward A. Merrill** died August 19, 1991, in Tulsa, Okla., at age 91. Ed, as most of us know, was a retired partner in the world-famous architectural firm of Skidmore, Owings and Merrill. He came to Tech as a sophomore after a year at the University of Minnesota. He was elected to Frieze and Cornice, played the violin in the Tech Show Orchestra, and was the high jumper on the '21 and '22 track teams. After graduation, Ed practiced architecture through the 20's and 30's in St. Paul and Chicago. In World War II, he served five years in the army engineers, mostly in Europe, retiring as a colonel. Shortly thereafter, he joined Skidmore, Owings and Merrill in which his older brother John, '21, was one of the original partners. Upon retirement in 1969, he turned his attention to Sherlock Holmes and the viola. He wrote monographs interpreting Arthur Conan Doyle's stories and played the viola in the Bohemian Club's Symphony Orchestra of which he was a member. Ed married Victoria (Vicki) Luthes in 1928 who survives him along with their twin sons, Frederick and Henry, and their seven children and grandchildren.—**Yardley Chittick,** secretary, Rte. 1, Box 390, Ossipee, NH 03864

23

As your secretary contemplates over notes, being due in September for the January deadline, his mind wanders to the change of seasons. The harvest and the winter weather are direct opposites, yet we must steel ourselves to accommmodate things, since we cannot change them. We live and we die, and the notes this time consist only of deaths of our classmates.

We report the death of **Benjamin Cooper,** a corporate executive, on February 22, 1991. He received the SB in business and engineering administration. As an undergraduate, he was a member of Corporation XV and the Menorah Society. Benjamin was married and we have no record of any children. He was president of Taller and Cooper, Inc., of Brooklyn, N.Y. In 1952, Benjamin developed a toll collection system used by nearly 100 bridges, tunnels, and expressways throughout the United States.

We have news that **George Gilman,** the lanky and happy one, died on June 2, 1991. He was a registered professional engineer and he spent his entire career working for Bell Laboratories. He served in many capacities, holding 11 patents for serious electrical developments, and authored several books. George received many awards, such as the John Hopkins Premium Award from the Institution of Electrical Engineers in England, a certificate of merit and token of gratitude from the Association of Japan-U.S. Amity and Trade Centennial and, most prominently, the Order of the Rising Sun in Japan. He married Dorothy E. Wilkins, and they lived in Rockport, Mass. He was a member of the First Baptist Church of Rockport and also of several clubs in the area.

News has reached us that **Francis LaVerne Smith** died on May 4, 1991, at Los Alamitos Medical Center, Texas. While an undergraduate, Francis was a member of the Chemical Society, Radio Society, and the Rifle Club. He married Dorothy Irene Smith of Colorado Springs, and they had one son and three grandchildren. After graduating, he worked as a chemical engineer for gulf Oil Corp., then became successively chief chemist for Hancock Oil Co. and chemical engineer for Signal Oil and Gas Co. of Long Beach, Calif. Francis also became secretary and director of Bell Flower Home Garden Water Co. and member of several prestigious clubs. His hobbies were the stock market and building a desert cabin. He resided in Bellflower, Rossmore, and Liesure World, Seal Beach, Calif., for 65 years.

Arthur LeFevre Hill, a corporation executive, was born in Denver, Colo., and died in Poway on April 28, 1991. He married Clara Louise Cleveland of Denver, and they had one daughter. Some years later he married Bernice Waterman Miller of Denver and had another daughter and acquired a stepson. Since retiring, he married Maria Von Kurz of Vienna, Austria. Upon graduation, Arthur was employed by the Ideal Cement Co. in its operations in Portland, Colo. From then on, he was connected with cement-linked operations on a high level. Later he became western sales manager of Darworth, Inc., a subsidiary of The Ensign Bickford Co. of Simsbury, Conn. He had a long connection in detonating fuses. Arthur was a member of the Colorado Section of the American Society of Mechanical Engineers, holding several offices. Similarly, as a member of several clubs, he served as an officer in each.

Bertram Eugene Warren, educator and author, died last June 27 in Arlington, Mass. As an undergraduate, he was a member of the Aeronautical and Chemical Engineering Societies, the Rifle Club, and was on the Track Team. He married Elna Peterson and they had two sons. He later studied at the University of Gotting and the Technischa Hochschule Stuttgart in Germany. Starting his career in 1931 as assistant, associate, and professor of physics at MIT, his life work was with the development of x-ray diffraction methods for the structure of matter. The more important applications were to the structure of silicate minerals. He was the author of some 120 scientific papers and a book, *E-Ray Diffraction*. He retired in 1967 but continued as a part-time lecturer at MIT. He received several honors for his work. Warren spent two six-month periods in 1957 and 1968 as visiting professor at the College de France in Paris and the spring of 1970 as visiting professor of the American University in Cairo. His hobby was fly fishing for trout at his camp in northern Maine.

We send our sympathy to the families of these classmates.—**Frederick O.A. Almquist,** secretary, 19 Griswold Rd., Wethersfield, CT 06109

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I have learned of the death of **Lester Twichell.** He passed away June 8, 1991. He is survived by his wife, Eleanor. He also left a daughter and a son, six grandchildren and two great grandchildren. The family requests that donations be made to the Braille Institute, 527 N. Dale, Anaheim, CA 92801. Our deepest sympathy to all of the family in your loss of a dear member.—Co-secretaries: **Katty Hereford,** Box 5297, Carmel, CA 93921; Col. **I. Henry Stern,** 2840 S. Ocean, #514, Palm Beach, FL 33480

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New Year's Day has passed, but there is still time to make a few resolutions. President **Courtenay Worthington** suggests that during 1992 each classmate resolve to write a note to the class secretary telling about his or her activities. Is that asking too much?

Hurricane Bob is history, although there are still many reminders about its destructive force. Cape Cod winds reached 100 miles per hour, but there was little rain. Thousands of trees were broken and uprooted. Power and telephone lines came down and there was much beach erosion. The entire Cape lost its power, and many people waited five to six days before getting it back. Those of us with private wells were in real trouble. Cape Ann, where Court Worthington lives, was on the west side of the eye, and while winds there were not much worse than a regular northeaster, four inches of rain fell within a short period.

We have just received word that **Maurice Grusky** died in Charlston, S.C. on December 24, 1988. Maurice worked for many years with the Knappen, Tippetts, Abbett Engineering Co. in Brooklyn, N.Y.—**F. Leroy (Doc) Foster,** secretary, 434 Old Comers Rd., P.O. Box 331, North Chatham, MA 02650

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Your class secretary returned home just after Labor Day. My stroke left my speech somewhat slurred, but I'm making great progress. The stroke also resulted in some internal digestive problems that require the use of special feeding tubes, which I hope are only temporary. My mind is still fine, and I read the *Wall Street Journal, New York Times, Newsweek, Readers Digest,* etc., and watch *The Nightly Business Report, Wall Streek Week,* etc. I would enjoy hearing more from classmates.

Howard R. Parker of Boxborough, Mass., died August 3, 1991. Howard was a retired load analyst for New England Power Co. He earned a master's in electrical engineering from Tech. After retiring from the power company, he worked as a consultant for Charles T. Main Co. He was a former Dedham Town Meeting member, as well as a member of the town's Finance Committee. He was also cubmaster of the Dedham Boy Scouts, Troop 3. Husband of the late Elizabeth Crane Tolman, he leaves his children, Willard T. Parker of Walpole, Mass., and Nancy C. Brown of Boxborough, and a large number of grandchildren and great-grandchildren.

Don't forget to send notes about what's going on in your life. Those of us who are still around like to keep in touch this way.—**Donald S. Cunningham,** secretary, Eventide, 215 Adams St., Quincy, MA 02169, (617) 328-1840

27 65th Reunion

As we begin our 1992 issue of the *Review,* we remind our classmates that this is the year of our 65th reunion. It's hard to believe. President **Harold (Bud) Fisher** and your secretaries ask for your response about our reunion activities and if you are planning to join us in Cambridge in June. We offer two suggestions: 1) To gather on the evening of Wednesday, June 3, for a reception meeting and class dinner at the Hotel Regency. This gives a day, Thursday, to visit MIT and Boston for those coming from a distance. 2) A minimum celebration would be at our Class ta-

bles at the usual Cardinal & Gray dinner at McCormick House (Thursday) prior to the Pops Concert. In either case, we would enjoy the usual events of Alumni Day. Friday rooms are available in dorms if desired with bus service to all functions and hotels. This will probably be our last attempt for a reunion gathering and we hope to see many of our hardy mates and your wives. Please respond.

Irving L. Hopkins of Mount Pleasant, S.C., died on June 12, 1991, after a long illness. After graduation, he worked with Bell Telephone Laboratories for 43 years in New York City and New Jersey and retired in 1970. After retirement, he taught at Princeton University for two years assisting Professor Tobolsky in the graduate school involving the subject of rheology. To his wife, Lois, who survives him and has moved to Ft. Bragg, Calif., we send our sympathy.—**Joseph C. Burley,** secretary, One Harborside Dr., Delray Beach, FL 33483; **Lawrence B. Grew,** assistant secretary, 21 Yowago Ave., Branford, CT 06405

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With this issue 1992 has arrived, which means that 1993 and our 65th Reunion is not far behind. While there is no rigid response or interest pattern to be expected, it was hoped that some details will begin to crystalize on which a committee can base preliminary plans for this, perhaps our last, group effort.

Hopes of attending have been expressed by **Sidney "Sid" Brown,** who also has a new address at 20 Bouton Green, Baltimore, MD 21210, after ending 18 years in Florida to return to his wife's home town. Also by Anne Tibbetts, who is still in their home in Reading, Mass., though **Willis Tibbetts** is in a nearby care facility. And **Carroll Smith** hopes to be at the reunion.

Another change in address, of Dottie and **Hermon Swartz,** now at 12 Minola Rd., Lexington, MA 02173, in a one-story retirement accomodation on the same property as their previous larger home.

I hope to have more concrete information about our 65th Reunion in the coming issues from the Alumni/ae Office and your committee—**George Palo,** (class agent and temporary class president), **Herm Swartz,** (reunion chairman), and your secretary.—**Ernest H. Knight,** secretary, Box 98, Raymond, ME 04071

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Your secretary suffered a mild heart attack in the early part of August which required a week in a local hospital in New Hampshire and a few weeks at home convalescing. This interlude might have caused a slight delay in some of your notes getting into print. Normal time is three months from the time a note reaches me until it appears in our '29 class notes. Most of us are in our mid-eighties and such an occurrence is not totally unexpected. It was a warning and I will abide by it.

A note comes from **J. Wesley Walters** (wife Josephine) of St. Paul, Minn., "I am happy to report that in spite of celebrating many birthdays, we are still able to continue daily hikes and travel around the United States by car. We have no arrival of new great grandchildren to report as yet." . . . Received a "Get Well" card from **Joaquin Llando** (wife Dorothy) for our auto accident. . . . A note comes from Dr. **Nathan Promisel** of Silver Spring, Md., who still persists "(but more leisurely) in my professional consulting, more in national policy than in technical details." Nate's hobbies include: photography, travel, music, and reading.

I received a note from **W. Gordon Bowie,** our class agent and (wife Sally). "I have just received a notice of the upcoming Leadership Conference which I would very much like to attend, but at this time we do not expect to make it. I guess the years are beginning to catch up as neither Sally nor I feel up to it. Among other things, driving in heavy traffic in unfamiliar areas presents a real problem. We do hope to make a brief visit to her hometown of West Newbury this fall, but we will not include Boston or Cambridge."

Richard E. Bolton of Westmount, Quebec, Canada, writes: "My eldest grandson was married in December to a delightful and talented Russian emigre in all the splendor of the Russian Orthodox Church. She and her family got permission to leave for Israel about 13 years ago and made their way to Toronto after spending a year of waiting in France. They are a family of great charm, kindness, and learning and have kept the Christian faith despite two generations of persecutions. Last summer, I motored through Maine on my way to Halifax, N.S., where I was met by a Col. A.E. Everest, who had the job I had in 1943–45, when I was responsible to the Admiral of Canadian Northwest Atlantic for the wellbeing of shore establishments on the east coast of Canada and Newfoundland. What improvements I found in H.M.C. dockyards in Halifax! The ship, *H.M.C.S. Terra Nova,* was in drydock for a quick inspection and shortly thereafter she left for the Persian Gulf."—**Karnig S. Dinjian,** secretary (23rd year), P.O. Box 83, Arlington, MA 02174, (603) 926-5363, (617) 643-8364

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The 1991 Alumni/ae Leadership Conference, which your secretary attended, was generally well planned and implemented. (*See Report in the Alumnews section.*) No one else from our class attended, but I had a chance to chat with Wyman Boynton, secretary of the Class of 1931. Wyman entered MIT with our class in the fall of 1926, but because of a lengthy illness he was forced to drop back a year. He knows a number of our classmates and has often provided me with items that have appeared in these notes. He now lives in Portsmouth, N.H. . . . During the course of the conference we were peppered with many statistics. But the one that particularly intrigued me is that there are now approximately 9,000 living alumni/ae who graduated more than 50 years ago. We oldsters have lots of company.

Ted Ross's career with GE and his long service as choir director of the Memorial Baptist Church in Fort Wayne, Ind., have been previously chronicled here, but his latest communication includes several new items. He recalls that in 1930 he established a new "high-hurdle record out behind the track house one Saturday." However, his triumph was rather short-lived; when "the track was moved across the street, the records chart began all over again." His latest volunteer activity is as a representative of the Allen County Commissioners on the Board of Indiana's Area III Council on Aging. Ted's wife Betty had the misfortune to break each of her legs at different times within a year, but is now able to get around with a cane. During Betty's convalescence, Ted became "proficient in many of the managerial skills of homemaking, shopping, and scheduling activities and appointments."

Ted Riehl has passed along the sad news that **Phil Holt** died August 30, 1991. In his note Ted recalls that he and Phil and **Jack Bennett** were roommates at MIT. According to my records, after receiving an SB in Course X, Phil worked for five years for Goodyear in Akron, Ohio, and then moved to Esso Research and Engineering Co. During his approximately 35 years with Esso, he worked on research and development and on research administration, positions that required travel to Europe and occasional Mid-Eastern trips to points as far away as Baghdad. During the latter part of his career he worked in general administration, including jobs as chair of the company bargaining committee and manager of executive development. He served six years as trustee of the local hospital in Summit, N.J., where the Holts lived for many years. After retiring in 1972, he painted in oils, watercolor, and pastels, and studied piano. Phil's wife Ottilia predeceased him. He is survived by a daughter, Frances, a son, Philetus, IV, and four grandchildren.

Queen Honors Cecil Green

During a 10-day U.S. tour last May, Queen Elizabeth II bestowed an honorary knighthood on Cecil Green, '23. Green, Dallas industrialist and founder of Texas Instruments, was honored at a private dinner hosted by the queen and her husband, the Duke of Edinburgh, at the Museum of Fine Arts in Houston. Green, who has endowed a new college at Oxford University, was among 100 guests, including Governor Ann Richards, former Ambassador to the United Kingdom Anne Armstrong, and University of Houston president Marguerite Ross Barnett.

Tony Savina kindly sent a newsclip about **Carleton Vanderwarker**'s unexpected death on August 21, 1991, as a result of complications from injuries he sustained in an automobile accident. Carleton worked for many years for the American Mutual Insurance Co. in White Plains, N.Y., and retired in 1973 as executive VP and general manager of the Eastern Division. The Vanderwarkers lived in New Canaan, Conn., where Carleton was active in local affairs. He was a charter member of the Town Council and served for 15 years. According to *New Canaan First Selectman,* "He had a deep interest in and understanding of the problems in town, [and] was a gracious public servant who always helped put at ease those appearing before the Council." He also served as director of the Senior Men's Club, United Way, Historical Society, and Nature Center. Carleton is survived by his wife, Patricia, sons Carleton, Jr., of Chicago and Peter of West Newton, Mass., and six grandchildren.—**Gordon K. Lister,** secretary, 294-B Heritage Village, Southbury, CT 06488

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On September 20 and 21, I attended the alumni/ae conference at MIT—a most interesting meeting—particularly since it was my first as secretary. **Randy Binner** did not make it—still being very careful after his quadruple bypass, but from over the telephone he is still the usual feisty Randy. **Gordon Lister** was there and was his usual congenial self. Also took in the other con-

ference for those of us who have interviewed prospective students for years—a most interesting and instructive one—and also the talks on why MIT needs funds—for building repairs and for more endowed chairs.

A note from **Carroll D. McCulloh** included a leaflet from the memorial service for **Clement "Clem" Hamblett** of Wilmington, Del., who died on August 13, 1991. Clement was a member of Alpha Chi Sigma and also served as president of the Chemical Society at MIT. He remained after graduation, getting an SM in chemical engineering (1931), and doctorate in inorganic chemistry in 1934. The following year he was in Paris as a Moore Travelling Fellow. In 1936 he joined Du Pont where he worked on research in the development of new processes for making chemicals and in the development of plastics. He retired about 15 years ago but apparently kept busy consulting, gardening, and fishing. He is survived by his daughter, Margaret.

Marguerite Probst, daughter of **William C. Lamb,** Theta Chi (electrical engineering), has reported he died at Tequesta, Fla., on April 4, 1991. After he left MIT, he secured employment with Gulf Resource and Development Co. in Pittsburgh. Later, he was a geophysicist with Gulf Oil in New York and Coral Gables, retiring more than 15 years ago.

Russell Holcomb Hoch, electrical engineering, of Braintree died at St. John Nursing Home after a brief illness. After leaving MIT he went to work with American Electric Furnace, Inc., of Dorchester and served as designer, treasurer, sales engineer, chief engineer, and eventually part owner of the firm, which is now located in Plymouth. He served as a deacon and trustee of the First Congregational Church of Braintree and was a member of the Braintree Lions Club as well as several engineering societies. He is survived by his wife, Greta, two sons, Douglas H. of Rochester, N.H., and Allen R. of Braintree, a sister, Mary Frances Jones of Bayfield, New Brunswick, eight grandchildren, and seven great-grandchildren.

Anne Duplin Waxton has advised of the demise of her mother Laurie B. Duplin, widow of **Victor J. Duplin, Jr.** on October 3, 1990. Victor died a short time ago.

Our condolences to the families of the persons departed, all of whom will be remembered for the good they have done in their lifetimes.—**Wyman P. Boynton,** secretary, 668 Middle St., Portsmouth, NH 03801

32 60th Reunion

On September 21, **Wendell Bearce,** his wife Maxime, and I were invited to join **John Brown**'s relatives for the luncheon at the MIT Alumni/ae Annual Awards. John Brown received the Howard E. Lobdell '17 award for his "loyal dedication and generosity to the Class of 1932, MIT Club of Boston, Alumni/ae Fund, and the Association of Alumni and Alumnae of MIT." We were all proud of John.

This was part of the Leadership Conference. Also attending was **Charles Spiegal** from California. He is still very active in furthering educational programs.

The following is a report of the Class of 1932 60th Reunion committee dated September 12, 1991. All suggestions are included. Some, of course, will be eliminated. We want your feedback. Write your preferences to us. Nothing is finalized yet.

In attendance: **Wendell Bearce,** Gift Chairman, Maxine Bearce, **John Brown,** Class President, **Melvin Castleman,** Class Secretary, **Frank Gowen,** Chairman of Nominating Committee, **Arthur Marshall, A.J. O'Neill, Thomas Weston,** Reunion Chairman, Ruth Weston, Nancie Barber (staff), and Carla Grayson (staff).

After much discussion, a tentative five-day schedule was approved. Major concerns were that the activities be of sufficient interest to attract alumni/ae from distant areas, as well as that "class" time be set aside for reminiscing, etc. Class activities will try to expand upon the Technology Day theme of internationalism.

Wednesday, June 3, Class members and their guests may arrive on campus after 1 pm to register. An informal reception and dinner could be held at McCormick Hall. It is possible to schedule a pianist or singing group for entertainment and a sing-along.

Thursday morning activities could include a lecture or discussion group led by a faculty member. Topics suggested by committee members were a general exploration of new technology and technology for Eastern Europe. Alternatively, there is a possibility that an MIT alumnus may be participating in the 1992 Olympics; a lecture or discussion about sports in this Olympic year is appealing. Nancie and Carla will investigate possible speakers. Options on the MIT campus could include a tour of the Artificial Intelligence or Media labs or a look at some of the new ceramic car motors or solar-powered vehicles being developed at the Institute. Keeping a grand tradition, Thursday evening is Tech Night at the Pops.

Developed by the Sloan School's Lester Thurow, the Technology Day theme on Friday, June 5, is "Technology in the Next Millennium."

On Saturday, morning activities could include manufacturing tours of companies around greater Boston (e.g., Bose, Digital, Analog Devices). Nancie and Carla will contact the Chambers of Commerce in the Lowell/Lawrence area for specifics. The Class could stop at the Wakefield Colonial Hilton for lunch, golf, and tennis on the way back. Saturday night would culminate in a Class of 1932 dinner. Mel Castleman will draft a questionnaire to guide a discussion tentatively titled "Reflections of Octogenarians," which could lead to an open-mike session.

Sunday activities will consist of a leisurely brunch for those able to stay on for a fifth day of reunioning. Our next meeting will be in late February or early March 1992.

We were informed that **Joseph B. Smith** died on November 22, 1990. He was a director of science at Salem High School for 20 years, and a consultant chemist for A.C. Lawrence Leather Co., CBS Hytron, and RCA Corp. He was active in many professional organizations.

Raymond K. Flege is enjoying good health and life in retirement at his home of many years in Atlanta, Ga. Mr. Flege writes that he enjoys gardening, bridge playing, and reading. . . . **Henry Rockwood** lives in Port Richey, Fla. He is retired and remains active in volunteer programs with the AARP, NARFE, SAR, and the Community Club. Mr. Rockwood is also active in the UNA-USA, the AMS, and the ASCE.

Keep writing! Send pictures!—**Melvin Castleman,** secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

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The reunion committee for the Class of 1933 60th Reunion met in Cambridge on September 30. The Reunion Executive Committee chair **Ferd Johnson** will lead the organization of festivities. The other members of the committee are: **Dick Fossett** (president), **Burt Webster** (treasurer), **Bill Klee** (secretary), **Steve Rhodes** (vice-president), **Charles Britton** (vice-president), **Herb Grier** (class agent), **Cy Hapgood** (estate secretary), and members-at-large **Berj Tashjian, Bill Huston, Werner Bachli, Len Julian, Art Hayden, John Hayes, Mal Mayer, Jack Andrews,** and **Ed Simpson.**

A tentative schedule will include a program beginning Wednesday, June 3, 1992, and extending to Sunday, June 7. The festivities will include the traditional Tech Night at the Pops and Technology Day celebrations, as well as a special two-day stay at the Sheraton Tara Resort in Danvers. We are all looking forward to this opportunity to renew old friendships. More details will follow as June 1993 appraoches.—**William B. Klee,** secretary, Box 7725, Hilton Head Island, SC 29938

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In Derry, N.H., last July 18, **Albert Hayes** died after a lengthy illness. He was in the Army in World War II, served as a designer for the Andrew Wilson Co. of Lawrence, Mass., for 15 years, and wound up as head designer of electrical kitchens for Breckenbridge of Boston. He is survived by a brother, Julian, in Derry.

Through **Carl Wilson,** I have word from Dorothy that her husband, **Olmstead "Stead" Wright,** died in Wheaton, Ill. This was unhappy news, as they had been regular attendees at our major reunions. Stead had spent his entire career as a fire protection engineer, largely with Texas Mutual Fire Insurance Co. and the Protection Mutual Insurance Co. As a consultant, he had traveled to Europe and throughout the U.S. and Canada, and for pleasure had cruised worldwide. I think his death was not sudden—Dorothy is already living at the Beacon Hill Retirement Home, 2600 S. Finley Rd., Lombard, IL 60148.

Jim Eder has sent me a compendium of notes he has received. **Gordon Burns** wrote: "Dot and I just returned from a short trip to see our daughter Janet and her husband in Miami. While there I took a tumble and broke my right wrist. With my arm in a cast we went to Savannah to an annual get-together with fraternity brothers and their wives. Among them were Natalie and **Sam Brown** and Mary and **Jim Eder.** Much of my spare time goes into a paper study of a somewhat unconventional approach to fusion power—*not* cold fusion. I'm trying to devise equations to put on my computer to see if this approach has any merit. When brain fag sets in, I shift gears and help Dot with her crossword puzzle." . . . **Warren Kuntz** wrote a while back about cruises on their boat. Warren's oldest son graduated 29 years ago from MIT and then the Sloan School; his youngest works at IBM near Wappinger Falls, N.Y.

Jim also had word from **Hank Backenstoss,** who says he has accepted a real challenge, that of the presidency of the Foundation for the Reading, Pa., Public Museum and Art Gallery. It's a big job, even for Hank. He has to raise $1.2 million every year to replace the funds formerly supplied by the public school system. In addition, he has the problem of who should run the museum—the political school board or a group of prominent citizens interested in it. The museum was created when Reading was the full-fashioned hosiery capital of the world. Considering that Hank was our reunion gift chairman for years, he seems to be a brute for punishment. Good luck, Hank!

Jim's final word is about **Wilton Lindsey** who he finds has been living in the same town, Chapel Hill, N.C., for the last five years. Wilton lost his wife a year ago and is living in a fine retirement center. He sold his Florida residence last year but still has a time-share condo on Sanibel Island. His daughter is a professor in the religious studies program at the University of Tennessee (Knoxville). Wilton enjoys life where he is and busies himself with gardening and furniture making.

The last input comes from **John Hrones.** It dates back to last May (my fault for it being so long in appearing) and goes: "I visited Beth and **George Fowles** in their lovely Sarasota home yesterday. They invited me over so Beth could instruct me in helping Peg, who is becoming less mobile. Beth was chief of the Department of Physical Therapy at Highland View Hospital in Cleveland for many years and has been active in her field nationally. They are headed for Boston to attend the America Physical Therapy Conference, then to spend some time on Cape Cod. They have a full plate ahead of them—a visit to a daughter in Pittsburgh, a cruise through the canal to Los Angeles, and while out west will see another daughter in Albuquerque."

A final unhappy item. I have just received a letter from a friend and neighbor of **Fran "Doc" Doyle** who writes about medical problems (heart and respiratory) that have beset him since November 1990. As of the friend's note (September 7), he was in a nursing home—Rest Haven Nursing Home, Route 61, Schuylkill Haven, PA 17972, but her letter made it seem dubious he would still be alive when you read this in January.

On a personal note, we are recuperating from the visit of my namesake, Hurricane Bob. There must have been small twisters inside the main storm—that's the only way I can explain what happened to us. There was no damage to our house, but we have counted over 90 tree losses in the land back of the house. They were almost all locusts—they are brittle and have shallow root systems. After the storm passed, the area looked like a battlefield. We were able to get a chain saw and help from a friend, so now we have about ten cords of firewood. But getting brush cleared and stumps pulled is an expensive operation.

This is written September 22, and we start our trip to the mini-reunion in Canada tomorrow. So, next issue I'll be able to tell you about it.—**Robert M. Franklin,** secretary, P.O. Box 1147, Brewster, MA 02631; **George G. Bull,** assistant secretary, 4901 N. Park Ave., #711, Chevy Chase, MD 20815

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John W. James wrote of his first trip to England and Scotland, when he recently accompanied his son there on a business trip. They stopped at the family home of Hal Davies near Petersfield, Hampshire. "Some of you may remember Hal, who was in the Course XV graduate program from 1934–1935" and lived in Ware Hall. "Hal was killed in the RAF during World War II, but I hoped to see his sisters. Unfortunately, one had recently died and the other had moved away. The beautiful turreted estate is being converted into apartments." John was strongly drawn to southern England in the Salisbury, Exeter, and Cornwall areas and says he may visit it again.

Stocky Stockmayer sent me "a little fill-in" information to pass along. Relative to a piece in the June issue of *Technology Review* about the passing of Professor Bill Greene, "only we oldsters would recall that he was universally known in our day as 'Profanity Bill' because his lectures were liberally sprinkled with 'hells' and 'damns'. I never had him in class, but I got to know him and his family well through the Faculty Drama Club. I spent some time each summer with him and Harriet's kin at Overlook Cottage on the Five-Mile Road in Jackson, N.H. There aren't many of our old teachers still around, but one of them is Hoyt Hottel, chemical engineering, who also used to visit Overlook with his family during the summers." Stocky wrote that he and Sylvia went to Sweden, mostly vacation and only about five days of science. On Midsummer's Day they were with some of Sylvia's cousins and even had their picture in the paper, dancing during the celebration on the green. Also in June, Stocky was made an honorary member of the Society of Polymer Science of Japan—only six Americans and three or four Europeans have so far received that honor. On August 18, Stocky played the piano with Janet Ahlquist in a Vaughan Recital Series at Dartmouth's Faulkner Recital Hall. The billing said "duo-pianists," but our man said it was like giving the bullpen catcher equal status with the starting pitcher, and it was embarrassing!

Julian H. Bigelow, Course VIA, was one of 27 members of the Cybernetics Group (now known as the Macy Conferences on Cybernetics). It was a consortium of natural and social scientists that met regularly during the war years to explore the use of scientific developments such as cybernetics, information theory, and computer theory as the basis for interdisciplinary alliances. They debated a range of topics, including insanity, language, vision, the brain as a digital machine, and how to make wise decisions. The MIT Press announces the availability of *The Cybernetics Group* by Steven J. Heims, a fascinating account of those meetings.

We have lost another of our '35ers: **Charles N. Debes** died August 31, 1991, in Rockford, Ill., after a short illness. He was chairman of the board of Debes Corp., which owns Alma Nelson Manor and Park Strathmoor Nursing Home. He is survived by his wife, Phyllis, three daughters, and six grandchildren.

Your secretary would be delighted to receive mail, especially from those who have never written. There may be less to talk about the older we get, but I am sure we are not a class of couch potatoes.—**Allan Q. Mowatt,** secretary, 715 No. Broadway, #257, Escondido, CA 92025-1872

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More items gleaned at Reunion: **Fred Prahl** (Course II) was at the 55th, though not at the 50th because his wife Dorothy was undergoing surgery at the time. She died in 1987, and in 1990 he married Mary Caldwell, a widow. "We two couples had been friends since we met during the 1938 New England hurricane. It was great for Mary to meet all the gang at the 55th." Fred was in shoe machinery for 30 years, first with United along with **Bill Prichard, Bob Gillette, Elmer Davis,** and **Elliott Robinson,** then with Compo, where he rose to vice-president. In between there was a year of product development at Singer, where **John Easton** was vice-president of manufacturing. Fred keeps his hand in, part time, designing special manufacturing machinery. Son Fred 3rd ('63) was also Course II, continuing on to an MS.

Jack Zietlow, a graduate of Trinity College, attended both the 50th and 55th reunions although he was with the class only during our senior year. However, he had a later Institute connection in 1976-77 when he took a course in the invention process. Jack is an active member of the Cape Cod MIT Club, and still runs his business on Martha's Vineyard under the name of Low Tech Inventions. . . . At Wianno, **Ariel Thomas** recalled the surveying camp in East Machias, Maine, after sophomore year, and brought camp pictures of **Tony Hittl** and **Bill Mullen.** Al and wife Avis were present at the Inaugural concert May 9. Also present for one or more Inaugural events were **Ken Arnold** and Pauline, **Eli Grossman** and Vivienne, **Pat Patterson** and Marian, **Dick Denton** and Virginia, and President **Alice Kimball.**

Pat reports a reunion jaunt from Wianno to Woods Hole "guided by Pauline and **Ken Arnold** in their van, with Helene and **Ollie Angevine, Alwyn Gray,** and Marian and myself. Pauline and Ken have fond memories of Woods Hole. Pauline worked in the Marine Biological Lab during her college summers. She met Ken in 1939 when he was on a fellowship at the Oceanographic Institute. Six weeks later they were married in a small white wooden church nearby, and they took us to see it and share their memories of 52 years ago." Ken earned a PhD at Tech in mathematics and made his career at Michigan State University as a professor of statistics and probability.

When Chance-Vought Aircraft moved from Connecticut to Texas in 1949, **Augie Mackro** went into business for himself with two partners, developing and producing optical comparators, and shadowgraphs with enlargement to identify problems of quality control. In 1960 Augie left the business to go with Sikorsky, but kept his one-third stock holding. The partners died leaving company insurance to buy one another's stock from the estates, and Augie became sole owner in 1971. He retired in 1982 and sold the company to a group of employees. As Augie put it, all he had to do was "sit and wait to own it all." Of course, he also had to outlive the partners, which he has done well, notwithstanding a replacement knee joint or two.

Harold J. Muckley, '39, spoke at the dedication cermony on October 4 when E40 at One Amherst St. was renamed the Dwight S. Muckley Building, honoring his father. The Corporation of MIT stated that it "will serve as an enduring symbol of the bonds of friendship that exist between this distinquished Texas family and the Massachusetts Institute of Technology." Harold and his wife, Elizabeth (to left of podium), were joined by several other members of the family from Texas (back row).

The 1936 *Technique* shows 14 of the Class in Course VII—biology and public health. All but one were from Massachusetts, mostly the Boston area. Three remain in the vicinity. . . . **Melvin First** was professor of environmental health engineering at the Harvard School of Public Health, where he earned the DSc in 1950. Now emeritus, he continues as consultant to his department. This includes contracts with the Department of Energy at Los Alamos, and in 1989 with the Chinese government, in the field of air and gas purification in nuclear power generation. He was in China with an antiaircraft battery during World War II. . . . There never was any question as to where **Ralph Mankowich** would get his pre-med education. His older brothers Abraham, '27, and Ivan, '33, had majored in chemical engineering. Ralph got his MD at Boston University and practiced industrial and sports medicine along with general surgery at the Institute, Brandeis University, and the Fernald School. He retired from general surgery in 1988 but continues to be active on the medical staff at Waltham-Weston Hospital. Ralph spoke of **Stanley Robbins'** text on pathology as "tops in the field." Stan, who is still active at Brigham and Women's Hospital, was on a trip to Alaska when I was in Boston.

Franklin Parker also had Institute connections—his father, Theodore, '11, was head of the civil engineering department in the 1940s. Frank was Course IV and did graduate work at the Harvard Business School. He joined Charles T. Main Engineering, where he designed industrial plants and worked up to a partnership. During World War II, he and **Dave Werblin** were together in New Delhi, sorting out CBI ordnance for transport to China: via air over the hump or on the ground via Burma Road. Frank is now retired except for some directorships, and in 1988 he published a history of the Charles River lower falls area, entitled "neare about the falles." It covers 300 years following the "setting off" of Newton and ten other towns from Cambridge in 1638. . . . More on visits at reunion time in next issue.

I visited **Jim Baker** and his wife Anne in Madisonville, Ky., in August. Jim is helpless and unable to speak following several strokes, but he does respond to conversation between Anne and visitors. Anne now has a van outfitted for a wheelchair, so Jim is no longer completely housebound and bedridden. The Bakers had attended nearly every reunion and know many of the class, so they were both very interested in the 55th group picture and list of attendees. Jim transferred from Vanderbilt University in 1933 to join the Class as a sophomore in Course X-B. After getting a BS and MS, he taught chemical engineering practice under Bob Gunness. He then worked for several years with Monsanto Chemical as plant superintendant in St. Louis and Norfolk, where he met Anne. The Baker-Hickman department store needed a new head, and surviving partner Hickman prevailed on Jim to come to the job in 1946. At Jim's retirement in 1982, accolades from employees, city officials, and the press attested his superlative management and community leadership as head of the "oldest business in the city under same family management—an island of quality in a discount world." Anne tells me that Jim followed the golden rule with customers and employees, including no-interest credit for needy families for school clothes for their children.

Anne is a community resource herself. In the late 1970s, the Madisonville Garden Club wished to memorialize former members. Anne, who was president at the time, suggested a "community improvement foundation," of which she became the president. For several years the foundation grew slowly. Then one man left a $250,000 bequest, and the fund took off. A $4.9 million, 1000-seat concert hall and arts center will be in the middle of its first season as you read this. Anne planted an acorn from which grew a great oak, with many and varied growing pains solved by the Bakers.

A toast in tribute to the lives of **Marcus Warmuth** and **Charles (Chuck) Kennedy!** Marcus (Course XVI) died August 24, 1990. When I visited him a year earlier, he talked of his experiences with the Army Air Force in World War II and later as engineer with Rohm & Haas and Engelhard Industries. Word of his death came from his wife Doris with a memorial gift to the Institute.

On an annual call to **Chuck Kennedy,** his wife Roselynn told of his dying May 1, after a long bout with cancer (January '89 NOTES), but keeping his good spirits to the end. Chuck (Course XV) ran Kennedy Valve Co. until a buy-out, then wound up his career as president and CEO of New York State Electric and Gas.—**Frank L. Phillips,** secretary, 1105 Calle Catalina, Santa Fe, NM 87501, (505) 988-2745; **James F. Patterson,** assistant secretary, 170 Broadway, Pleasantville, NY 10570, (914) 769-4171

37 55th Reunion

June, 1992—Newport, R.I.! That's the date and location of our 55th reunion, details of which have already been sent to class members. . . . **Joe Keithley** wrote, "Make it as pleasant as our 50th," and that's the aim of your reunion committee. . . . **Pete Reitz** has taped much of the popular music of our undergraduate days. We hope your 1992 schedule includes your attendance at our 55th!

Received the following letter from **Henry J. Stuart.** "In January of my senior year, my family had a change of name, thus some classmates may remember me as **Hank Sokolosky.** Also, I was a 'brownbagger.' These have contributed to a quasi-anonymity over the decades. Consequently this update. My career in aerospace started post-World War II, with scavenged V-2 rockets in Alamogordo/White Sands Proving Ground and ended with General Dynamics in tactical missiles—the last being Stinger. Millie and I are enjoying retirement in good health in our San Diego home of 30 years, catching up on long-postponed travel and recently celebrating our golden anniversary. I am into videography, Millie is into Ikebana—Japanese flower arranging. Rotary, MIT Club, docenting, growing materials for Millie's arrangements, and some 'hangin' out' make time fly. We are still seeing classmates and their spouses—**Hughie Smith** and Nancy of Escondido, Calif., and **Paul Vogel** and Fran of Portland, Maine. I look forward to every issue of *Technology Review* for class news and appreciate the great job secretary Bob is doing." I hope Hank's letter will encourage other class members to give us an update on their lives and activities.

Eugene Cooper's main interests are: 1) keeping up his science and related knowledge by association with University of California, San Diego, and Naval Ocean Systems Center, 2) classical music, playing piano and collections, 3) swimming and walking, and 4) ladies. He suggests that since the reunion is in Newport, we should schedule some sailing. . . . **Frank Kierstead** and his wife Hermione, both electronics technicians, have retired. "Not much change in interests, except much more active in church work. Much busier now than before retirement."

Joe Keithley now has the title of founder of Keithley Instruments, having given up the title of chair in February 1991. Joe is listed in *Who's Who in America.* His main interests are "measuring instrumentation in general, Keithley Instruments specifically. I am working with the IEEE Society for Instrumentation and Measurements on two histories. One is a multi-author work on electronic measuring instrumentation, written by those who have made substantial contributions. I am writing the introduction. In addition, I am writing a large version of the history of electrical and magnetic instrumentation from the earliest days to 1900."

Received sad notices that **Rolf Schneider** passed away January 24, 1991; **Edward L. Vollmer** on January 18, 1990, and **John W. Aldrich** on August 25, 1991. John was an engineer for Scovill Manufacturing and later superintendent for Platt

PHOTO: BARRY HETHERINGTON

Brothers Manufacturing. He retired in 1983 from Waterbury Buckle, Woodbury, Conn., where he was plant manager. He leaves his wife Margaret, two sons, and one grandson. Our condolences go to the Schneider, Vollmer, and Aldrich families.—**Robert H. Thorson,** secretary, 66 Swan Rd., Winchester, MA 01890

38

This month's notes, although scarce, are a combination of coincidences and sadness. Our architectural alumna, **Gretchen Binge,** of Sunnyvale, Calif., forwarded a recently discovered card which was signed by 18 sitting at her talk at what obviously was a hangout in 1937 or 1938 in Boston. Some of the names you will surely recognize: Van Bush, the eminent architect Gropius, and three classmates—**Sol Kaufman, Mert Barrows,** architect and later president of the firm of Royal Barry Wills, and **William E. Hartmann,** later senior partner of Skidmore, Owings and Merrill.

Now for the painful news. **Corny Roosevelt**'s sister informed us that he died August 3 of a heart attack at his Washington, D.C., home. Corny, a retired official of the Central Intelligence Agency, was not one to volunteer news about his work and little about his personal life in spite of constant urging by your secretaries. As most know, he was the grandson of President Teddy Roosevelt. A bit of research discloses that after graduation from MIT he spent four years in Mexico as a mining engineer, followed by four years with the Navy (finally, Lt. Commander). Subsequently he worked in China and the Far East until 1952. There he was president of Wm. Hunt and Co. until the Chinese Communists took over the mainland. He then returned to Washington where he was consultant to the Office of Naval Research and co-founder of Linderman Engineering Co. From 1952 he consulted in technical fields to the CIA, FBI, Secret Service, and Office of Naval Research. He retired from his principal contact, the CIA, in 1973.

He was director of various high tech companies, such as Aerospace Corp. of Los Angeles. Corny was an enthusiastic scuba diver (certified scuba instructor), traveling all over the world diving and taking underwater photos. He and his close friend and classmate, **Peter De Florez,** traveled together extensively, scuba diving and hot-air ballooning. He was an ardent collector of Japanese art and artifacts. Many of us will vouch for his sister's description of him as "patient, methodical, talented, and brilliant in so many ways, with a quiet sense of humor."

Another classmate whom we had implored to write us of his many civic activities was **Haskell Gordon.** He finally sent us a mini-biography which **Ed Hadley** incorporated in the November/December class notes. Ironically, a few days later, August 13, he was in an automobile accident and on September 17 died as a result of the injuries.

Haskell was a long time patron of the arts, devoted to the Boston Symphony Orchestra. Speaking for the family at Worcester's Temple Emanuel was his daughter Susan. As special tribute, three members of the BSO performed a Beethoven trio for strings. One of the pall-bearers was our classmate, **Sal Kaufman,** also mentioned above. Haskell's own biographical sketch in the previous *Review* issue concentrated on his most recent project for the BSO—consultant on the design and construction of a magnificent new outdoor concert hall for chamber and solo presentations and a home for the student orchestra at the Tanglewood Music Center. Consequently, it seems appropriate here to mention some of Haskell's many civic contributions he did not include in his own write-up. They covered a remarkable range: past president of the Worcester Jewish Federation, Worcester County Music Association, Temple Emanuel Brotherhood, Fellow of Brandeis University, and Sustaining Fellow of MIT. He was a major donor to the Rose and Gorden Cancer Building at the Worcester Foundation for Experimental Biology, the Rose Building at St. Vincent Hospital, and the Rose Chapel of Temple Emanuel, and he established the Samuel and Rebecca Gordon Scholarship Fund for his Temple. Among his board memberships were the Worcester Foundation for Biological Research, WGBH, Board of Overseers of the BSO, MIT Council for the Arts, and Incorporator of the Worcester Art Museum. Memorial Contributions may be made to BSO, Symphony Hall, Boston, in support of the Haskell R. Gordon Fund for the new concert hall at Tanglewood or to any charity of the donor's choice. Haskell had accepted the chairmanship of our forthcoming 55th Reunion. Our hearts go out to Iva, his widow, who for three decades has, with Haskell, been active in all our class affairs.

In closing—do keep in mind our June 1993 55th Reunion to be held both at Harbor View Hotel on Martha's Vineyard and on campus. Members of your committee have already visited the hotel in the course of planning all your reunion events.—**Don Severance,** secretary, 39 Hampshire Rd., Wellesley, MA 02181; **Ed Hadley,** assistant secretary, 50 Spofford Rd., Boxford, MA 01921

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John Alexander and **Bob Withington** phoned their arrival in Bob's Cessna at a sportplane airport near our house. I joined them for lunch and exchange of news. Bob was carrying a new book, *The Road to the 707* by William H. Cook, '38. Bill and Bob made major contributions to design and construct Boeing's first large-scale wind tunnel.

Bob and Betsy celebrated their 50th wedding anniversary by chartering a 72-foot sailing yacht for a 10-day cruise around the islands of northern Puget Sound. The crew included nine others, all family. After this reunion, Bob flew his Cessna 25 to Oshkosh, Wisc., where he attended the annual convention of builders and buyers of small aircraft.

George Estes authored a note in the Andover *Alumni Bulletin,* which Fred Grant relayed: "After 36 years with United Aircraft Technologies, I retired as vice-president of its International Corp. Betty and I built our dream house in Ponte Vedra, Fla., where I became director of the Ponte Vedra Community Association, the P.V. Municipal Service District, senior warden of Christ Episcopal Church, and president of the board of directors of Vicar's Landing, an upscale not-for-profit life-care community of 240 apartments and a 60-bed health center on all 26 acres of land abutting the Tournament Players Headquarters and Golf Course. Exhausted after five years of bringing this $4.7 million project to fruition, I resigned my offices and joined a golf group in P.V., where Betty and I enjoy a wonderful life."

Fred Grant continues: "**Manny Morrill, George Beesley,** and **Paul Stanton** drafted a reunion questionnaire. We expect to mail it during September to those who attended the 45th and 50th."

Wiley Corl reports a by-product benefit of his convalescence from a heart attack: weight reduction to a slim-trim 165 pounds. Wiley volunteers services to patients at a nearby hospital. From time to time, he remembers a month-long voyage made before 1935 on Count Von Luckner's four-masted sailing schooner to the Caribbean Islands not far from his current residence at Boca Raton, Fla.

Hewett Phillips, a research associate at NASA's Langley Research Center, has been elected to membership in the National Academy of Engineering. He is cited for "exceptional theoretical and practical contributions that have substantially advanced aircraft stability, control, guidance, flying qualities, and simulation technology for the benefit of mankind." Phillips earned bachelor's and master's degrees in aeronautical engineering from MIT. Among his awards, he received a

Holden W. "Bob" Withington, '39, hasn't left the world of flight. He still flies his Cessna sportplane, although retired as vice-president of engineering of the Boeing Commercial Airplane Co. where he directed the supersonic transport development program.

presidential citation in 1964 for his work on the lunar rendevous and docking simulator, several NASA awards including a NASA special award for the Shuttle approach and landing test program, NASA medals for both exceptional scientific and engineering achievements, and a special award for Shuttle flight control contributions. He was also honored with the President's Award for Distinguished Federal Civilian Service in 1979. Phillips and his wife, Viola, live in Hampton, Va.

George Hulst retired after an active career in the electronics industry and enjoys barbershop singing. George directs the SPEBSQSA Chorus in Venice, Fla. His quartet won medals as Senior Champion Quartet of Southereastern U.S.A.

George Gremer drew on his inexhaustable reservoir of enthusiasm to join professional colleagues on last June 6 to celebrate installation of a retired A-12 Blackbird at the Aerospace Historical Center in San Diego. During the last 28 years, there were three versions of Blackbird aircraft that set world absolute speed and altitude records. On March 6, 1991, one of the Blackbirds flew from Los Angeles to Washington, D.C., in 68 minutes. Speed averaged 2,113 miles per hour! **Jim Barton** reports that a similar retired Blackbird in Seattle is being prepared for permanent display at the new Aerospace Museum near Boeing Field.

Manning Morrill suggests adding an item for those who missed the prior announcement of deaths of two favorite professors: Fred Fassett and Bill Greene. Manning says: "Here were two wonderful men who brought a sense of fun and entertainment to the otherwise mundane subject of English. It was a pleasure to have studied under both of them."

My call to North Carolina State University produced the sad report that Professor **Willard F. Babcock,** 74, died April 15, 1988. Bill was professor of civil engineering at North Carolina State University from 1940 to 1957 and from 1969 to 1988. From 1957 to 1969, he was the state highway administrator for the North Carolina State Highway Commission. During his long career of state service, he won many prizes and awards including: seven teaching awards, NCSU Alumni Distinguished Professor Award, the Western Electric Award of the Southeast Section of the American Society for Engineering Education, and the James Laurie Prize of the American Society of Civil Engineers in 1978 as the outstanding transportation engineer nationally.

Before these notes are published, I expect Hilda and I will have a new address.—**Hal Seykota,** secretary, 2853 Claremont Dr., Tacoma, WA 98407

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Recently, past president **Jim Baird** with Melissa, treasurer **Dick Babish** with Jo, and I went to Newport, R.I., to scout out several of the hotels, with the 55th Reunion in 1995 in mind. We were

unanimously in favor of the Viking, as it has charm and atmosphere that the others lacked. In addition, it has been used by other MIT classes, and the rates are more favorable than those of other hotels. I have reviewed the information with president **Norm Klivans,** and will work through the Alumni/ae Office to make preliminary arrangements to go there. With all the famous summer "cottages," the beautiful harbor, nearby golf and tennis, and the quaint atmosphere of the town, it should be a great place to celebrate together. It is still a long way off, but it is never too early to make plans.

In planning for the visit to Newport, I spoke with several other classmates about the arrangements. **Marty Abkowitz, Edgar Bernard, Dan Blitz,** Sally (Mrs.) **Bob Bittenbender,** and **George Wolfe** all were enthusiastic about the tentative plans. While they were unable to join us in the visit, they all thought it was a great idea.

More recently, I ran into **George Wolfe** while we were both pushing our carts around the supermarket. George spends some time each week helping his brother, who operates a travel agency. With this contact, George was able to provide us with some valuable information concerning the Newport hotels. . . . On a recent visit to my daughter in New Jersey, I spoke to **Amos Joel,** and we made a date to have lunch together in the near future. Amos is still busy doing consulting work, and was about to leave on a business trip to Washington. He enjoys being busy, and keeping his hand in doing the work that he loves. . . . A letter from **David "Beano" Goodman** expressed his interest in the January 1993 mini-reunion in Naples, Fla.

John M. Kirk passed away on July 1, 1991, in Rockport, Mass. John graduated from Middlebury College, and then joined our class to study metallurgy, while working the night shift at Zurbach Steel Co. in Somerville. After working for a steel tubing firm, he formed the partnership of Rolled Steel Products Co., and a few years later, established the John M. Kirk Co. as a manufacturer's representative. He was a charter trustee of Middlebury College, and was an overseer at the time of his death. The Alumni House there was named for the Kirks in 1979. The class sends its sympathy to John's family.

Keep those letters coming.—**Richard E. Gladstone,** secretary, 1208 Greendale Ave., Needham, MA 02192, (617) 449-2421

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Interesting details not provided in reunion biographies have cropped up in notes and press releases. . . . **Lew Jester,** of Marion, Ohio, sailed in the islands in February, and in May from San Diego to Hawaii. To quote: "36-foot sloop, 23 days, 3 in crew, 3 hours on wheel, 6 hours off. Still skiing—NASTAR medals, etc. Now ski free—over 70. Go for it!" . . . **Bill Bowes** of Capistrano Beach, Calif., married with three sons and eight grandchildren, retired from TRW San Clemente in 1985. He now works part-time in real estate, has traveled in Europe and the U.S. and plans to go to Australia and New Zealand next. He likes sailboat racing and snow skiing. Last ski trip Mammoth Mountain, Calif. . . . **Milton Sanders** and his wife, Frieda, of Lincroft, N.J., returned from Montevideo, Uruguay, in March. He was recruited as a volunteer by the not-for-profit International Executive Service Corps and volunteered to assist a local manufacturer of electric and phone conductors to determine the feasibility of manufacturing fiber optic cable. . . . **John Murdock** has completed similar volunteer efforts in mining and metals processing, for the same organization in Turkey and Zimbabwe.

An alert **Sandy Glick** spotted a picture of the widow of **Hank Avery** on page 4 of the recent inaugural special edition of the *MIT Spectrum.* Sandy forwarded it to the very alive Hank, seen by all of us at the 50th in June. Sandy's Twainsian remark, "I though you ought to know that the report of your demise is premature." Hank added, in a note to **Sepp Dietzgen,** "My wife Mary Ruth is now very suspicious!" Good news for all of you that may have seen the item!

At the 75th anniversary of the School of Chemical Engineering Practice, as honored guest, retired chairman of the MIT Corporation, **David Saxton,** chided me, that the same *MIT Spectrum* pictured identified him as Class of '38 instead of '41. I was disappointed that no classmates had noticed this and that no other Course X classmate who also attended practice school was at the historic and nostalgic celebration. Two high points were when Professor Emeritus Hoyt Hottel, my SB thesis advisor, sang two bits of doggerel he had composed to document a pratice school goof and his own research activities in the early days of the MITSCEP.

George Wambolt Clark, Topsfield, Mass., died at Mass, General Hospital on August 9, after a short illness. A Course VI and advanced ROTC (Signal Corps) graduate, he served as a lieutenant colonel in the Pacific Theatre during World War II. Active in school activities at MIT and member of the track team for four years, he was a wearer of the "T." For many years, until his retirement four years ago, he was employed as an executive manager for the General Telephone and Electronics Corp. He was former president of the Illuminating Engineering Society and the International Commission on Illumination. The class and his Delta Tau Delta fraternity brothers extend their sympathy to his wife, Robin, his son, daughter-in-law, and two grandchildren.

Please keep sending news and don't be discouraged if it does not appear immediately. There is a 10-week lead time after the Class Notes editors get my input.—**Charles H. King, Jr.,** secretary, 7509 Sebago Rd., Bethesda, MD 20817, (301) 229-4459

42 50th Reunion

Though the reunion still seems a long way off, **Jerry Coe's** 50th Reunion Committee is hard at work. Thus far, we'll head the commencement procession on Monday, June 1. President's reception and Pops concert are on the 4th, and the Technology Day program is on Friday, the 5th.

The well-traveled Leveres visited Vietnam and Cambodia, including stops at Ho Chi Minh City, Da Nang, Hue, and Hanoi, and also at Bangkok and Hong Kong. **Bernie Levere** swam with Henry Kissinger in the Mandarin Hotel pool in Hong Kong. Would think he's the only classmate who has swum with an ex-Secretary of State!

Note from **Bob (Hawk) Shaw** tells that his MIT daughter, Lib, has moved to California with brothers Rob, Chris, and Oni. . . . Copy of a letter from **Hugh Schwartz** to **Bill Hecht** trying to get the MIT Alumni/ae Association to include Hugh in our class where he belongs. . . . **Lou Rosenblum** is still doing very interesting things with typefaces and graphic arts, including translations of non-Latin alphabets.

One obit this month: **Will Yocom** died in August in Winsted, Conn. In addition to his wife, Alice, Will leaves a son and two daughters. Our condolences to the family.

Note the new address, where you can *flood* us with class news!—**Ken Rosett,** secretary, 281 Martling Ave., Tarrytown, NY 10591

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Two other graduates of Course X, **Chris Matthew** and **Hans Walz,** have reported the death of **Fred Perry** last July 25 in Jackson, N.H. Fred was a native of Wellesley, served as an Army captain in the Pacific during World War II, and then returned to MIT for a master's degree in 1947. The next 34 years, until his retirement, he spent with Arthur D. Little, Inc. During his career, Fred served as president of the Boston Section of AIChE (the "Ichthiologists"), member of the Wayland Planning Board, director of the Wildcat Mountain Corp., and vice-president of the national Swedenborgian Church. We extend our condolences to Fred's wife Nancy, his four sons, and the other members of his family.

No other news is at hand, except that Susan and I are leaving soon for a lengthy tour of Europe, where we hope to see **Virgilio Barco** and **Hugh Parker.** You may not find a 1943 Class Notes column in next month's *Review,* but send your news anyway. It will appear eventually.—**Bob Rorschach,** secretary, 2544 S. Norfolk, Tulsa, OK 74114

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The 1991 Alumni/ae Leadership Conference was held on Saturday, September 21. In attendance were **Lou Demarkles, Paul Ely, Jr., Edgar Eaton, Jr., Melissa Teixeira, Caspar Schneider,** and **Stan Warshaw.** The annual meeting of the MIT Alumni/ae Association was convened with reports on the financial well-being of MIT. President Vest spoke on the issues for the next decade. They are many and complex. Since the Federal Government is the largest sponsor of research at MIT, he has established a liaison office in Washington, D.C., to represent MIT's interests and coordinate with all other research educational institutions. The person heading this up has had over 20 years experience representing higher educational institutions to the Federal Government. President Vest is fully involved in leading MIT into the next century.

An interesting development is that starting with the class entering in the Fall of 1993, all students will take biology as a core subject. Once again MIT is leading the way in engineering and science education.—Co-secretaries: **Andrew Corry,** P.O. Box 310, W. Hyannisport, MA 02672; **Lou Demarkles,** 77 Circuit Ave., Hyannis, MA 02601

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Please send news for this column to: **Clinton H. Springer,** secretary, P.O. Box 288, New Castle, NH 03854

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Well, it's zilch here on the eve of the 45th Reunion and nothing in the mailbox, so I'll just pass along an apology to **Ned Tebbetts,** whom I overlooked writing about in the Technology Day item I submitted for October. Ned has been one of the busier members of our Class, both before and after graduation. He has lived in Cohasset for quite some time, working as an actuary with Mutual Life in Boston and is presently running for the Massachusetts Senate. He was reunion chairman for our 25th Reunion and has had a lot of experience in class organization.

If I can get my act together, I plan to make a birthday list for our class and will be sending birthday wishes, provided, of course, I don't go broke and my mind is still operating. Any comments or advice?

Hope you all had a happy yuletide, happy birthday to Ned on the 24th.—**Jim Ray,** secretary, 2520 S. Ivanhoe Pl., Denver, CO 80222

47 45th Reunion

Our pleas for news from classmates paid off with two letters this month!

Alan McClennan was recently reelected president of the Chatham Yacht Club, secretary of the Eastward Ho! Country Club, and treasurer of the Friends of Pleasant Bay. All these activities are related to the elbow of Cape Cod. Alan continues as a trustee of the Cape Cod Museum of Natural History and also serves as a member of the Property/Building Committee of the First Parish

Brewster Unitarian Universalist Church. In addition, he is working with the Town of Orleans in the development of a resource management plan for the Orleans portion of the Pleasant Bay area of Critical Environmental Concern. Sounds like Alan is busier now than when he was "working"!

John R. Wittels started at MIT with the class of '43, but joined the staff of Gibbs & Cox, Inc. (ship design agents in New York City) in the wartime summer of 1942. After two years he returned to MIT, only to leave again for a two-year stint in the Navy. He had the good fortune to serve aboard the *USS Fort Marion* (LSD 22), a ship he helped design at Gibbs & Cox. With the war and naval service behind him, he returned to MIT and graduated in 1947. He pursued various business ventures until 1949, when he rejoined Gibbs & Cox as a ship designer. While in New York he met his future bride, Annalisa L. Akerstrom. They were married in her hometown of Riddarrhyttan, Sweden, in 1950 and are still happily married. In 1951, John joined the staff of Lockheed Aircraft Co., Burbank, Calif., and eventually became department manager on the Polaris Project. When that wound down, he joined ITT Gilfillan Inc., in Los Angeles, Calif. (radar designers and builders) as division manager, Engineering Services. During that period, he became active in the MIT Club of southern California, ultimately becoming its president. John retired from Gilfillan in 1977, but in 1978, he "unretired" and joined Hughes Aircraft Co. as staff to one of the directors. Hughes subsequently moved him to its facility in Tucson where he has lived for the last two years. He likes the desert scene and says he expects to stay there when he retires in November. But considering his history, he may not stay retired for long!—**Robert E. McBride,** secretary, 1511 E. Northcrest Dr., Highlands Ranch, CO 80126

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Lou Kreek has been active in the Kiwanis Club for six years. In 1989–90, he was president of the Akron club, which has 100 members. He recently began serving as division lieutenant governor for ten clubs near his home in Akron, Ohio. The Kiwanis are celebrating their 75th anniversary, and the Akron club was 20th to form of the 3,000 clubs currently active. Lou's wife, Gwen, continues to be an active volunteer among Wellesley alumnae. Gwen has been a Girl Scout or Girl Scout leader continuously since the age of 7. She is a tour guide at a historic house built by Charles Siberling when he was president of Goodyear years ago.

The following classmates attended this year's Alumni/ae Leadership Conference last September: **George Clifford, Peter Saint Germain, Milton Slade, Lou Kreek, Harry Jones,** and yours truly. Peter Saint Germain is president of the MIT Alumni/ae Association. He conducted the Saturday morning session and presented awards to alumni/ae at the luncheon. In the evening, Peter and his wife, Janet, joined George and his wife, Ginny, at a table during the dance held in President Vest's honor.

The weather cooperated for our mini-reunion with the classes of 1947 and 1949 last September on Martha's Vineyard. Walking was the most popular activity, followed by talking, eating, dancing, and automobile touring. Robert M. Solow, Institute Professor of Economics, spoke to the group about interest rates, productivity, and business levels.

Members of our class attending were: Margie and **Denny Allegretti,** Ruth and **Al Baum,** Anne and **Ken Brock,** Barbara and **Paul Buckingham,** Mary and **Art Fowle, Ed Hanley,** Joan and **Sam Hanna,** Charlotte and **Bob Hanpeter,** Martha and **Bill Katz,** Gloria and **Sonny Monosson,** Jeanette and **Bob Ormiston,** Eleanor and **Harold Ottobrini,** Mary and **Bill Riordan,** Tel and **Bob Sandman,** Jean and **Milt Slade,** Judy and **Graham Sterling,** Marcia and **Bob Wofsey,** Louise and **Tom Zsembik,** and yours truly. Five members of '47, and 11 members of '49 completed the group.

Fred Richards retired from his position as Sterling Professor of Molecular Biophysics and Biochemistry at Yale and is now professor emeritus. A specialist in protein structure, he discovered that enzymes continue to exert their catalytic activity in the crystalline state, thus paving the way for the use of X-Ray diffraction for analyzing three-dimensional protein structure. Recently, he worked on nuclear magnetic resonance procedures for protein structure analysis. He is a member of the National Academy of Science.

Mike Kami writes in his quarterly newsletter: "To achieve 15 percent annual growth when GNP growth is 2 percent, some other company must be forced to grow at -13 percent. You have to kill the competition. This is happening in airlines, department stores, banking, construction, software, and automobiles. In order to win, target the loser, by name!"—**Marty Billett,** secretary and president, 16 Greenwood Ave., Barrington, RI 02806, (401) 245-8963

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In a recent column about the trip from Boston to Toledo being made by Dot and **Jim Christopher** in their sloop, I warned that it is illegal to sail a sloop over Niagara Falls. But **Larry Collins** writes: "Of course, it's legal to take a sloop over the falls."

"I was there," he continues, "when Dot and Jim went by and got this picture." Enclosed was a spectacular shot of the Christopher sloop, taken close in from a helicopter, just as it was going over the brink.

I'm going to say flat out that I think Larry is pulling my leg because I doubt he has ever set foot in a helicopter. Anyway, since I want this report to be factual, I called Niagara Falls and found that, some years back, the number of sloops shooting the falls was getting out of hand. Tourists complained that the huge sails blocked the view and Captain Phineas Boatwhistle of the little tourist boat, *Maid of the Mist,* which sails perilously close to the base of the falls, objected that he could never be sure when some damn windjammer might come down on him.

Accordingly, Niagara Falls has an ordinance which reads: "Sailing a sloop over Niagara Falls is a misdemeanor punishable by a fine of ten dollars or ten days in jail or both." I hope this clears up any confusion created by Larry's letter.

Getting back to earth, **Ed Capen** writes that he has been retired since 1989 from the Rockwell International Corp. in Downey, Calif., where he served for 17 years as a project engineer in the area of design and control for the Space Shuttle Program.

Each year in September, the Institute sponsors an event called the Alumni/ae Leadership Conference. All those doing volunteer work for the school are invited. What it boils down to is that the Institute pulls out all the stops to give the attendees a great time. There were seven principal speakers, each of whom proved to be an outstanding platform performer. Those from our class on the list of attendees were **Raffaele Belluardo, Elda Chisholm, Bob Cowen, Earl Eames, Fletcher Eaton, Don Gillespie, Dick Morel,** and **Ed Thompson.**

During the Awards Presentations at lunch in Walker Memorial, Ed Thompson received the Harold E. Lobdell '17 Distinguished Service Award" given in recognition of alumni relations service of special depth over a sustained period." Ed's citation read: "for his unique and extraordinary contribution to the Institute and the *Technology Review* Board and magazine, and for dedicated service to Corporation Visiting Committees and Board of Alumni and Alumnae of the Massachusetts Institute of Technology." Edward T. Thompson may, perhaps, be best known as the former Editor-in-Chief of the Reader's Digest.

Back in October, **Frank Hulswit,** assistant class secretary, reported on the activities of the Class of 1949 Scholarship Fund in which he quoted from a letter from one of our scholarship recipients, Anna Jen. Another letter, this one received by **Tom Toohy,** class president, also deserves quotation. From Yvette Morgan, '92:

"I was very pleased when I learned that I was one of the recipients of the Class of 1949 Scholarship Fund. I have always considered it a kind act of humanity when a person who has achieved great things occasionally turns around and helps those who come behind him. It is an even greater joy when a group of people, such as the Class of 1949, get together for a common goal because a group of people all of one mind can achieve great things. I thank you very much.

"I feel that I should tell you a little about myself. In the fall, I will be a senior in the field of Brain and Cognitive Science, with a special interest in the cognitive development of children. I am currently an undergraduate research assistant to Dr. Susan Carey investigating the question of how children learn to recognize faces. My goals include attending graduate school in clinical psychology.

"On a more personal side, I am originally from Fayetteville, N.C., and I am the elder of two daughters. Some of my leisure time activities include music (I am a guitarist), rock climbing, and rugby.

"My experience at MIT has been full of ups and downs. Every day there is a new goal to achieve, a new problem to solve, and a new challenge to face. Looking back on it, I wouldn't trade it for the world."—**Fletcher Eaton,** secretary, 42 Perry Dr., Needham, MA 02192, (617) 449-1614

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Please send news for this column to: **John T. McKenna,** secretary, 182 Midpine Rd., Box 376, Cummaquid, MA 02637

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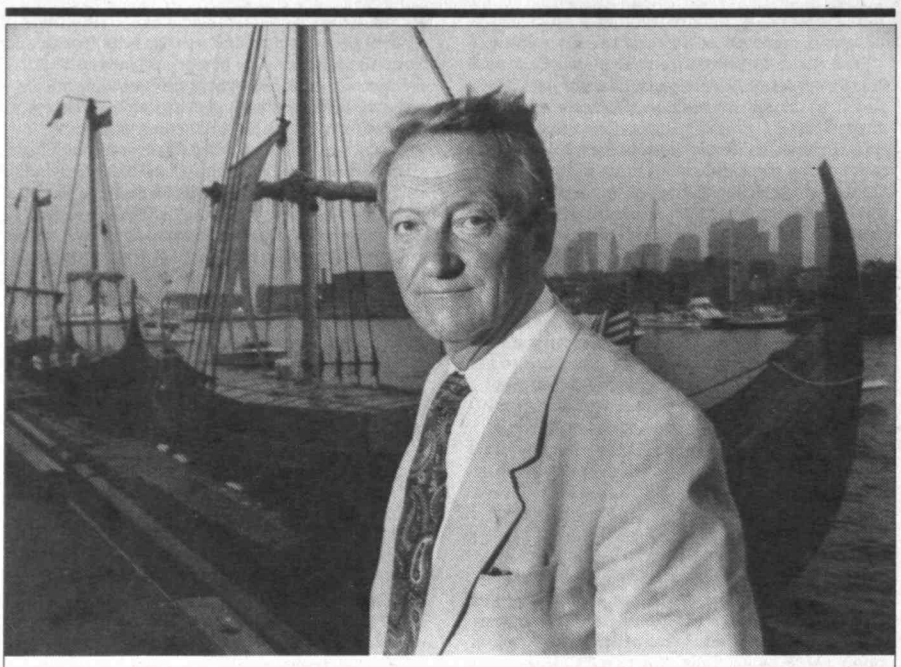
The Massachusetts Society for the Prevention of Cruelty to Children has recently elected **William Ramsey** to their board of directors. Bill, who lives in Newton, Mass., is the executive director for Engineering Special Programs at MIT. He also devotes a great deal of his time to the Second Church in West Newton and the City Mission Society. . . . A recent article by Paul Harvey presented the views of Dr. **Amar Bose** on the reasons for the success of Japan compared with the United States in furthering their economic interests. He pointed to their government and industrial cooperation in long range planning that contrasts the almost adversarial relationship that exists in this country.

Last month your secretary had a welcome treat in being invited to an evening rehearsal of a flute and piano chamber concert presented by Donna Hieken, the very charming and talented wife of **Chuck Hieken.** Donna is both a marvelous flutist and a very interesting person. She had uncovered the music manuscripts of the program at a small shop while on a recent trip to Moscow. In addition to her playing, Donna discussed much of the background of the pieces, the composers, and their relationship to other contemporary works. It was a most enjoyable evening spent at the home of two very warm and personable friends.—**Martin N. Greenfield,** secretary, 25 Darrell Dr., Randolph, MA 02368

52 40th Reunion

Sam Mitchell thoughtfully send me a newspaper clipping of **Howard K. Larson**'s obituary. Howard died August 31, 1991, after a 37-year career at NASA/Ames Research Center in Mountain View, Calif. In 1980, Howard has lost his larynx, tongue, and part of his jaw to cancer. In spite of be-



Millionaire with a Mission

Knut Kloster knows full well that money talks. The retired head of his family's billion-dollar Norwegian cruise line, Kloster is worried about global issues such as the environment and the way different cultures interact. And he's willing to spend some money to spread his concerns.

Kloster, '51, an ocean-engineering alumnus, is the sponsor of three reproduction Viking ships that sailed from Norway last spring to tour the North American coast. The voyage of the distinctive curved-prow ships marks the thousandth anniversary of Leif Ericson's much-debated journey across the Atlantic. The ships also bring Kloster's message: Human beings must be as adventurous and resourceful in saving our planet's resources during the next millennium as they were in conquering new worlds in the last thousand years.

Altruistic as he may appear, Kloster is still a businessman. While spending millions to bring the Viking ships and their environmental message to U.S. ports last fall, the Norwegian also was at work building the world's largest cruise ship, a gas-guzzling extravaganza complete with an amusement park. Kloster knows the two projects seem at odds, but he offers his vision of the jumboliner: Each cruise will offer courses in the culture and language of the ports of call, education that can help break down tourists' we-them mentality.

"You can say [building the cruiseliner] is crazy, that it is using all these resources to build and run such a big ship," he says. "On the other hand, it's an opportunity to have 5,000 to 6,000 people in your hand and educate them about cultural diversity, change their behavior."

At a gathering of the MIT Club of Boston in September, alumni/ae inspected the Viking ships docked at the Charlestown Navy Yard and heard Kloster speak on global responsibility and the ills of materialism. One alumnus rose to ask about Kloster himself: Does he lead a Spartan lifestyle? Did he experience some moment of inspiration that sent him out to change the world?

"Absolutely not. This is not like a religious conversion," he says. "I'm still driving my Volvo around; I can't say I'm different from anyone else."

Still, Kloster's retirement hardly consists of rounds of golf and bridge. "I've been very lucky as a businessman, I've made some money, and I made the decision to spend it this way," he says.

"I've always been concerned with the way we operate as business people. If you ask a businessman what it means to be profitable, he'd say to get a return on your capital—money. But we have to give capital a broader definition. It can mean human resources, social influence—these are things to also get a return on."—*Lisa Watts* □

ing voiceless, he continued in his position as chief of the NASA thermal protection branch, responsible for testing developments in heat shielding for the space shuttle. He communicated by longhand and typewriter, and served as a guinea pig for the development of speech synthesizers linked to keyboards, eventually enabling him to "speak" by typing.

In 1982 Howard was named Federal Handicapped Employee of the Year, but in a few years he had left his handicap behind. A colleague said of him, "When he first had the problem, he used to say he was disabled and could have taken early retirement, but now that he wasn't disabled anymore, he couldn't retire." Unfortunately, the cancer recurred last year, and he finally had to stop working. He is survived by his wife Pat and three sons.

Sam writes that Howard was a neighbor of his in Saratoga, Calif. As for himself, Sam says that he retired from the Nuclear Division of GE a few years ago.—**Richard F. Lacey,** secretary, 2340 Cowper St., Palo Alto, CA 94301

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Please send news for this column to: **Gilbert D. Gardner,** secretary, 1200 Trinity Dr., Alexandria, VA 22314, (703) 461-0331

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Please send news for this column to: **Edwin G. Eigel, Jr.,** secretary, 33 Pepperbush Lane, Fairfield, CT 06430

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Notes are really getting thin, classmates. It may be a little bit excusable during the busy summer months leading up to this column's writing, but now that we're into the cold dull winter months, there's plenty of time to jot down a note or two about your recent professional achievements, job changes, retirement plans, life style, or whatever. We're interested! Let's hear from you!

David Brooks (Course XII-A) writes that he has met several classmates during the past year. He is now head of the Environmental Policy Program in Canada's International Research Centre, a crown corporation supporting research projects in the developing world. Two of Dave's favorites (at least for purposes of field work!) have been research on non-destructive fishing for aquarium fish on the coral reefs of the Philippines, and development of sustainable livelihoods for people living within the boundaries of the nature reserve around Mt. Everest in Nepal and Tibet.

Last winter, Dave and Toby took advantage of all his accumulated frequent flyer points and visited classmate **David Nasitir**—not in California where one might expect to find him, but in Florence, where David was in charge of Cal State's Year Abroad program. David and Marilyn had a magnificent apartment in the heart of historic Florence, which made sightseeing easy and (somewhat) less expensive. Then, in May, they both went to Washington and had dinner with **Ellen Dirba Harland,** who recently shifted from running her own architectural firm in New Mexico to managing a building evaluation system in the federal government.

Dave's other big news is that, much to his amazement, he was appointed to the board of directors of Ontario Hydro—the largest electrical utility in the western world and one of the largest corporations in Canada. He can't decide whether environmentalists like him are gaining power or being co-opted!

Duwayne Peterson continues to make the news: the *Wall Street Journal* reports that the retired executive vice-president of Merrill Lynch & Co., has now been appointed to the board of directors of Goal Systems International, Inc., of Columbus,

PHOTO: BARRY HETHERINGTON

Ohio.—Co-secretaries: **Roy M. Salzman,** 481 Curve St., Carlisle, MA 01741; **James H. Eacker,** 3619 Folly Quarter Rd., Ellicott City, MD 21042

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One hundred and forty-one classmates and their guests enjoyed a lively and fun-filled 35th reunion in Boston September 26-29.

On Friday a very informative panel of speakers including **Harris Weinstein,** chief counsel, U.S. Treasury Department, presented a program on "Ethics in Technology and Management." That evening alumni sock hopped in '50s dress at the MIT Museum. Saturday began with an eye opening astrophysics lecture by our own Class of 1956 supported Professor Edmund Bertschinger. A barbeque followed outside the Johnson Athletic Center where everyone had a chance to get updated on the latest family events and class news. The evening began at the Omni Theater in the Museum of Science with a showing of the *Blue Planet* and was followed by a gala dinner dance in the Skyline Room. On Sunday Dean Lester Thurow was our guest speaker at a brunch in the Skyline Suite of the Royal Sonesta Hotel. Dean Thurow gave very timely insights into the events unfolding in Europe.

Many thanks to outgoing class president **Ron Massa** for his leadership and contributions these past years. Ron presented the Class of 1956's gift of $412,535 on Technology Day June 7. This 35th reunion gift was a first at MIT and was achieved under the leadership of co-gift chairs **Richard Jacobs** and **Harris Weinstein.**

Many thanks to all the 35th reunion committee members for planning a very successful and meaningful event. Classmates enjoyed renewing past relationships and learning of each others' latest accomplishments.

Our new class officers are **Lloyd Beckett,** president; **Richard Jacobs, Theodore Korelitz, Harris Weinstein,** senior vice-presidents; **Walter Frey,** class agent, **Klaus Kubierschky,** treasurer; **Michael Turin,** class book; **Theodore Korelitz,** 40th reunion chairman; **Irwin Gross** and **Ralph Kohl,** co-secretaries.

Our vice presidents are **George Brattin, Paul Cianci, Peter Dulchinos, Gideon Gartner, John Gignac, Margolia Gilson, Larry Goldberg, Charles Hazard, Gordon Kane, Merlin Lickhalter, Robert McGillicuddy, Barry Novins, Philip Schaffer, Philip Trussel, Sven Vaule,** and **Andrew Viterbi.**

Our board of directors is as follows: **Warren Briggs, William Grinker, Ronald Massa, William Northfield,** and **Martin Reiss.**

Send news to **Ralph A. Kohl,** secretary, 54 Bound Brook Rd., Newton, MA 02161

57 35th Reunion

Sal Pomponi recently made a successful ascent of Mount McKinley, Alaska, the tallest peak in North America. After waiting out a storm for four days at 16,000 feet, Sal and three companions were rewarded with two days of exceptional weather and attained the 20,320 foot summit on June 21, 16 days after leaving base camp. To commemorate the event, Sal unfurled an MIT pennant. Sal has a number of high altitude ascents to his credit, including Aconcagua, at 23,000 feet the highest peak in the Western Hemisphere. Sal lives and works in Bedford, Mass. He is a technical director at the Mitre Corp. with responsibility for international command and control programs. His daughter Renata graduated from Tech in Course VIIIA in 1990.

David Lukens is now teaching math and science at Shimer College in Waukegan. He lives in Evanston, Ill. . . . **Steven Mason** is now vice-chairman of the Mead Corp. in Dayton, Ohio. He was formerly the president and chief operating officer. . . . **Boyd Givan** is the corporate senior vice-president of finance for the Boeing Co. He was formerly vice president of financial operations. . . . **Dennis Begaby** is director of venture development for Community Energy Alternatives, a subsidiary of Public Service Enterprise Group of New Jersey. . . . **Michael Allik** has become an independent businessman after purchasing two small manufacturing companies.

Peter Samton is president of the City Club of New York, the oldest civic organization in the city. His firm, Gruzen Samtom Steinglass does substantial school work, including the new Stuyvesant High School and new prototype school for the Board of Education. They are also involved in large-scale planning projects and in hotel design. The firm celebrated its fifth anniversary in April. . . . **Edward Roberts** has written a book, *Entrepreneurs in High Technology: Lessons from MIT and Beyond.* Published by the Oxford University Press, the book has received glowing reviews. It deals with the factors affecting the success or failure of high-tech firms and with the working experiences and family backgrounds of successful entrepreneurs.

Howard Schumacher died of a heart attack on March 2, 1991. Hod served in the Air Force in Turkey and the Aleutians and worked at General Dynamics in Rochester. For the last 13 years he had been chief engineer and headed the Manufacturing Division for Eltrex Industries. He is survived by three children, two in college and one in law school. He was a popular and well-known member of the class and will be missed by all of us. . . . **John Carbone** died on February 27, 1991. He is survived by his wife, Virginia, his brother, **Guy Carbone** (also of '57), five other brothers and sisters, and a large extended family.—**John T. Christian,** secretary, 23 Fredana Rd., Waban, MA 02168

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Please send news for this column to: **Mike Brose,** secretary, 1619 Greenleaf Blvd., Elkhart, IN 46514

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Please send news for this column to: **Allan S. Bufferd,** secretary, Office of the Treasurer, MIT, 238 Main St., Suite 200, Cambridge, MA 02142

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Happy holidays to everyone. I hope that 1992 will be a year filled with health, happiness, prosperity, and peace for all.

Like the last column this one is getting perilously close to either a forlorn announcement of "send news items to. . ." or regaling you with (1) tales of my family and what I did on my summer vacation or (2) making this a forum for your class agent. Neither is a good alternative to what I could write if some of the 700 plus members of '60 took a few moments to drop me a line or two.

A recent edition of the Bethleham, Pa., *Globe-Times,* reports that **Joseph Goldstein** received the 1991 Presidential Science Award from the Microbeam Analysis Society. Joe, the R.D. Stout professor of materials science and engineering at Lehigh University, was honored for his contributions to analytical electron microscopy. Joe has been a member of the Lehigh faculty since 1968 and has published more than 160 technical papers and seven books. During a recent sabbatical he worked both at Eindhoven University of Technology in the Netherlands and at Sandia National Laboratories, N. Mex.

Lastly, an item of the just-in-case-you're-interested variety—you can now make your gift to the Alumni/ae Fund by electronic funds transfer. For more information contact Laura Scarlett, Room 10-116 at the Institute, or telephone her at (617) 253-8247.—**Frank A. Tapparo,** secretary and class agent, 15 S. Montague St., Arlington, VA 22204

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Bob Pease has been on the phone lately asking for names of lost '61ers. It seems he writes a column called Pease Porridge, an Analogue Ramble, in *Electronic Design.* By putting names of these lost souls in the column Bob thinks we might be able to get hold of them. I got a list of 28 lost Course 6 classmates and sent it off. If you need an address please let me know. It's easy to get them from the Alumni/ae Association. Bob has come out with a fancy new book called *Troubleshooting Analog Circuits* published by Butterworth- Heinemann. The blurb on the back says he is "one of the legends of analog design."

Don Easson writes that he and wife Ginny moved to Chicago back in 1988 and they really like the area. Don works at Davy McKee where he is director of process engineering and technology. They design and build manufacturing facilities for pharmaceutical and fine chemical companies. Don's son got an ScD at MIT in 1984 and now runs his own company in Worcester.

Finally a note from **Wesley Hilton** who writes, "After three years operating independently as Hilton Software, I seem to have made the adjustment from wage slave to entrepreneur. Life is much more fun this way. I recommend it."

Thanks for the letters and keep them coming.—**Andrew Braun,** secretary, 464 Heath St., Chestnut Hill, MA 02167

62 30th Reunion

Our 30th Reunion will be held Thursday, June 4, through Sunday, June 7, 1992, and the reunion committee has held its first meeting. We intend to have as much fun as we did at the 25th, and hope that all members and friends of the MIT Class of '62 will be there in Cambridge to enjoy the events with us. More on this as plans take shape. For now, we have assurances from **Dave Stare** that he can supply the Dry Creek wines to enliven our meals and receptions on the same basis as for the 25th. This has warmed the heart of at least one wine connoisseur at the MIT Alumni Office who plans to celebrate the event with us.

Received a short note from **Hal Waller** who has been appointed Associate Dean (academic) of the Faculty of Arts at McGill University in Montreal, Quebec, where he has been teaching political science since 1967. . . . In 1990, Daniel and **Hal Elazar** published *Maintaining Consensus: The Canadian Jewish Polity in the Postwar World.* The book won the 1991 National Jewish Book Award in the United States in the category of Contemporary Jewish Life. I concur with Hal's assessment of these achievements: "Some would consider this quite an accomplishment for an old mechanical engineer." . . . **Elwyn Berlekamp,** professor of mathematics and electrical engineering/computer science at the University of California at Berkeley has received the Richard W. Hamming Medal from the IEEE. Elwyn was cited "for profound contributions to the theory and application of error-correcting codes."

Murray B. Sachs, has been appointed the new director of the Johns Hopkins University School of Medicine's Department of Biomedical Engineering. This program is rated number one in the nation by two independent surveys. Murray has been on the biomedical engineering faculty at Johns Hopkins since 1970, and has been serving as professor in neuroscience, otolaryngology, and more recently as director of the Johns Hopkins Center for Hearing and Balance.

It is my sad duty to report that **Robert L. Covey** died on March 11, 1991. Bob had lived with his wife, Dr. Anna K. Covey, at 392 South Main St., Hightstown, NJ 08520. I'm sure Anna would appreciate condolences from mutual friends and Bob's classmates.

Drop me a line when you get the chance.—**Hank McCarl,** secretary, P.O. Box 352, Birmingham, AL 35201-0352

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I have a few fine tidbits for you this time. One is naming of the first recipient of the Class of 1963 Phi Delta Theta Scholarship Fund. James Williams, '91, of El Paso, Tex., was president and financial chair of PDT and majored in biology. He participated in varsity cross-country and indoor and outdoor track. He also held several part-time and summer jobs while an undergraduate. As of last summer, his plans were medical school or graduate school in a life science, followed by a career in the medical area. Congratulations to Mr. Williams and to those who made the award possible.

We have our first (known to me) retiree. **John Addis** has retired after almost 28 years with Tektronix designing vertical amplifiers for oscilloscopes. John never married, but he invested well, making his retirement possible. Earlier John had contributed a chapter to *Analog Circuit Design—Art, Science, and Personalities,* published by Butterworth-Heinemann. Some other MIT-associated people joined this effort, including editor Jim Williams, and Phil Perkins, **Bob Pease,** Jim Roberge, and Samuel Wilensky. John describes the book as ". . .an interesting collection of not very technical thoughts and light reading on analog circuit design. . ." Light reading indeed! John is enjoying his retirement—traveling and consulting, and finding the summer months especially delightful. He lives at 9365 S.W. Palomino Pl., Beaverton, OR 97005.

I got a press release about **Henry Reeder.** He has been made a Fellow of the American Institute of Architects, an honor conferred for notable contributions to the profession. Henry is a principal with Architectural Resources Cambridge, a firm he helped found 22 years ago. They have designed buildings for many U.S. schools and universities, including renovations for MIT Buildings 10 and NW17.

I recently joined Columbia Medical Plan, a large HMO in metro Baltimore. The work involves database and spreadsheet programming to analyze the productivity of their 140 or so doctors and a similar number of other providers. I am also continuing part-time my consulting practice in software training and database programming. My son Gary has returned to MIT's grad school in cognitive science after a summer working with a professor in his field in Duesseldorf, Germany.

Please write, phone, or send me an e-mail message.!—**Phil Marcus,** secretary, 3410 Orange Grove Ct., Ellicott City, MD 21043, (410) 750-0184, CompuServe 72047,333, Internet: 72047.333@compuserve.com.

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Greetings of the New Year. May it be a happy and healthy one for all!

There is a single, lonesome item this month—a letter from **Bob Gray.** He writes: "A couple of recent events motivate me to write you with some news. The first and most important is that my wife Lolly and I became grandparents on July 27. . . . My wife and I were at Woods Hole when the baby arrived (I was attending a conveniently timed NRC workshop on Visual Factors in Image Communication) and we met the baby while he was still only a few hours old.

"The second news item is that I just finished my fifth book. . . . *Vector Quantization and Signal Compression* by Allen Gersho of UCSB and me, will be published by Kluwer Academic Press of Boston in mid-October (1991). . . . All in all, a fairly productive summer. I am still a professor of electrical engineering at Stanford, where I have been teaching since 1969. Most of my research work these days is with medical image compression and enhancement and oversampled analog-to-digital conversion. I still live in La Honda in the nearby hills and travel to Boston whenever I can find a good excuse."

The return address on Bob's stationary served to remind me that there is another way for many of you to communicate your news and views to me. I can be reached via e-mail at: joseph_kasper@dartmouth.edu. Please warm up your digits and tickle those keyboards; the mail pouch is empty.—**Joe Kasper,** secretary, RR2, Box 4, Norwich, VT 05055

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Our classmates were deeply saddened to hear of **Margaret MacVicar's** death September 30, 1991. Margaret was an extraordinary individual who contributed substantially to MIT and our class. Her work as Dean of Undergraduate Education at MIT was exemplary. (See MIT pages 8-13 for a more complete report.)

I had an enjoyable conversation with **Yazan Sharif** recently. He is still president at Harbison-Walker Refractories, a division of Dresser Industries. Yazan's wife is in her third year of law school (law is booming, I am told. See **Steve Deutsch's** notes below). Yazan's daughter is at Tufts, and his son is at Miami of Ohio.

Steve Deutsch is now head of the litigation group at Foley, Hoag & Eliot in Boston. He says the result is that he isn't doing much law. Steve says that as things go less well for businesses, they stretch out their quarrels—so his business is booming. His daughter Nancy is in her third year at Vassar, son Jeff is finishing high school at the Rivers School, and young daughter Elizabeth just entered kindergarten.

Suti Prakash writes that he is director of client services at a direct-marketing agency. He finds the work challenging and enjoyable. . . . **John Groves** was appointed to the Hugh Stott Taylor Chair of Chemistry at Princeton. John's area of research is metalloenzymes. . . . **Phil Smith** reports that he became president and COO of Kilovac Corp. in January 1991. Kilovac makes high-tech vacuum power relays. Phil reports that he had dinner with Will Taylor ('62) in Palo Alto, and that Will has all his hair and is still thin.

Dick Schmallensee is back in Cambridge after his stint on the President's Council of Economic Advisors. He returned in June 1991 and immediately took responsibility for re-energizing MIT's Center for Energy Policy Research. Dick said he enjoyed Washington, but it's nice to be back to a somewhat normal life. He enjoys spending time with his two sons (age 9 and 12), who are normal boys and therefore into sports and all that. Dick's interest in the energy center derives from time he spent in Washington working on environmental and energy issues. He sees a critical interplay between the two particularly in the effect of energy use on global climate change. Also, while the U.S. has efficient energy systems, consumption is high because we have large houses and drive long distances.

My group, Beacon Venture Management, has also gotten into a number (four as of October) of environmentally related ventures. Passage of the Clean Air Act Amendments in 1990 will drive major changes to the country's environmental activities over the next 20 years, which, in turn, generates opportunities to commercialize technology. I'd be interested in other classmates' experiences in the emerging activities around the environment.—**George McKinney,** secretary, 33 Old Orchard Rd., Chestnut Hill, MA 02167, (617) 890-5771

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Not a lot of *new* news this month, three letters to be exact. Also, **Jeff Kenton** passed along a few treasures to keep us going for awhile.

Richard Millman is now academic vice-president at brand new California State University San Marcos. He notes some concern about coping with the weather there as compared with his former location in Dayton, Ohio, where he was Dean of the College of Math and Science at Wright State. . . . Also enjoying the California weather is **Marty Melnick.** He is manager of electronic system projects at TRW Electronics and Defense in Redondo Beach. He and his wife spend their weekends shuffling between the various sporting activities of their children Matthew (13) and Marissa (10). . . . **David Wilcox** sounds too busy to enjoy the California weather. He has three jobs. He is still president of the aerospace firm he founded in 1973, teaches at UCLA, *and* teaches at USC. His wife of 26 years, Barbara, dabbles in a variety of activities from decorating to business management. Daughter Kinley runs her own tanning salon and son Bob is working on a degree in electronics. . . . **Thomas O. Jones** continues as president and chairman of Epsilon Data Management Inc. in Burlington, Mass., and has now become a member of the Board of Trustees for Andover Newton Theological School.

Larry Hoffman writes that after 12 years living and practicing law in the Washington, D.C., area, he is now associated with a NYC law firm where he specializes in product safety, product liability litigation, and defense. He is married and has two children, 22 and 8. He would like to hear from classmates in the NY area or others travelling through. . . . Perhaps **Mark Haber** will drop in. He went on for an architecture degree and then a degree in project management. For 12 years he has been involved with the management of design firms. He has been in New York and Boston and is now back in New York City where he has his own consulting business. He is an instrument rated private pilot and getting ready to go for his commercial license. . . . **Michael Kraus** has left Massachusetts to join the National Oceanic and Atmospheric Administration's forecast systems lab in Boulder, Colo. He works on aviation weather support. . . . **Marty McGowan** is back east after many years in Colorado, on the technical staff of Bell Labs in New Jersey. . . . **Bob Atkins** is professor of chemistry at James Madison University in the Shenandoah Valley of Virginia. He volunteers on a regional hazardous waste materials team. . . . Another professor is **Wilson Tang,** associate head of the Civil Engineering Department at the University of Illinois at Urbana-Champaign. He had enjoyed a mini-reunion in Rhode Island with other class members from Hong Kong, **Richard Ho, Daniel Pang, Arthur Kwok, Christopher Leong,** and **Lawrence Lin.**

Victor Nedzelnitsky is still at the National Institute of Standards and Technology, formerly called the National Bureau of Standards. He is involved in precision electroacoustical measurements. . . . **Dimitri Procos** organized a Passive and Low Energy conference in Halifax in 1990 and is editing the resulting book. He is working with a Canadian agency on solar settlements in the Egyptian desert and will be taking a sabbatical to the University of the Aegean, Greece, and the Urban Land Institute in Washington. . . . **Mel Goldman** is also away from his normal job at the World Bank to look at European innovation programs and policies at the Science Policy Research Unit, University of Sussex, England. His oldest daughter Alissa is at Amherst College and the two youngest are suffering a traditional British education. His wife Dorothy is doing experiments on fertility at the same university. . . . **Aaron Z. Snyder** is now district sales manager for microwave and RF instruments at Tektronix, Inc. He writes, "Little did I realize when I used my first Tek scope in my 6.71 lab that I would eventually end up working for the company. . . . not just once, but three times!"

Seasons greetings to all of you.—**Eleanore Klepser,** secretary, 84 Northledge Dr., Snyder, NY 14226

67 25th Reunion

Plans for our 25th Reunion from June 4 (Thursday) through June 7 (Sunday) are progressing well, and we expect record attendance for our

class. Do attend. Better yet, call **John Rudy** at (508) 858-5768 if you wish to help in the effort. On Thursday there is MIT Night at the Pops, preceded by a buffet for our class at the Hyatt Regency in Cambridge. Friday is Technology Day at Tech, and there will be a reception for our class at President Vest's home in the late afternoon and a dinner dance at Fanueil Hall in the evening. On Saturday afternoon the entire family will enjoy a clambake at Noble and Greenough, a beautiful private school in Dedham, and in the evening we will have a good time at the newly refurbished MIT Faculty Club. A Sunday brunch at the Student Center will wrap up the Reunion. If you have not already done so, I urge you to complete the questionnaire for our Class Book. **Lutz Henckels** is doing a great job in spearheading this effort, and he needs your cooperation.

I enjoyed having lunch with **Jeff Wiesen** on a recent business trip to Boston. He and **Gary Garmon** have graciously agreed to serve as co-chairs for the Class of 1967 25th Reunion Gift. Jeff is a partner in the Boston law firm of Mintz, Levin, Cohn, Ferris, Clovesky and Popeo. Jeff's wife, Elaine (whom he met in the 6th grade), teaches English subjects at Solomon Schecter Day School in Newton. They live in Lexington, and their twins are now juniors in college—Daryl at Brown University and Rachel at Hobart William Smith College. I also enjoyed a visit with Eric Johnson at MIT during my trip. Eric is director of MIT's Industrial Liaison Program. He and Kathy, who also works at MIT, were married in 1968 and now reside in Sharon. Their daughter Mari is a sophomore at Ohio Wesleyan, and their son is a senior in high school. After graduation Eric worked for Kennecott Copper for a few years in Cleveland and Salt Lake City, and he received a master's in operations research from Case Western in Cleveland in 1971. Eric returned home to MIT in 1972 and has been there ever since, except for two years in Italy in the early '80s when he was director of marketing for Zanussi.

Stuart Orkin, who is the Leland Fikes Professor of Pediatric Medicine at Harvard Medical School, has been elected as a new member of the National Academy of Sciences. As you know, election to the Academy is one of the highest honors that can be accorded a U.S. scientist or engineer. . . . **Gillie Beram** is currently teaching creative writing to 7th and 8th graders at Fayerweather Street School in Cambridge. Gillie participated in a collaborative study of the Fayerweather Street neighborhood as homage to Kevin Lynch. . . . Patty and **Ed Radlo** have a new baby, Graeme Michael, who was born January 15, 1991. Ed is a partner at Fenwick & West in Palo Alto, Calif., where he specializes in patent law. . . . **William Ford** has had his "Macintosh Assembly System BasePak" software published by D.C. Heath. His textbook, *MC68000 Assembly Language and Systems Programming* is the top selling text in its field, and a second edition is scheduled for the spring of 1992. Further Macintosh software is scheduled for release in 1992.—**Jim Swanson,** secretary, 878 Hoffman Terr., Los Altos, CA 94024

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The mail has been sparse lately, but enough has accumulated to write a short column.

Our summer was marked by a couple of special events. First, we took advantage of the bad economy and bought a larger sailboat, so we have been enjoying the luxuries—and bearing the extra work—that more space and more amenities offer. Second, we tore ourselves away from the boat for a few days in July to head for Hawaii to see the eclipse. Since we decided to do this at the last minute, there was no room at the inn, but as luck would have it, a friend of a friend has a sister who knew someone. . . . We ended up in a traditional Hawaiian fishing village, the last on the island, and had a delightful time. While on the island, we saw Ken ('65) and **Aviva Brecher.** Ken was there professionally to lecture on the eclipse and do an experiment at the solar observatory. The eclipse itself was a cliffhanger, as cloud cover threatened all morning. We were fortunate to find a spot that cleared just before the eclipse, and we had a marvelous view. Unfortunately, the Brechers and a whole lot of other people were not so lucky. Nevertheless, if you can stand going halfway around the world and then being subjected to the vagaries of weather, we recommend that you try to see an eclipse sometime.

Congratulations are due to several classmates this month. . . . **Robert Horvitz**, professor of biology at MIT, was recently elected to the National Academy of Sciences. . . . **Thomas Romer** was appointed professor of politics and public affairs at Princeton University, effective last July 1. Thomas came to Princeton from Carnegie-Mellon. In 1979–80, he was a visiting economist at the Federal Trade Commission. A political economist and an authority on the regulatory process, he is the author or co-author of 30 publications. He won the Joint Council on Economic Education Award in 1975, and the Duncan Black Award in 1980. . . . **Ellen Greenberg** writes that, since August 1990, she has been director of the MBA program at the University of Massachusetts in Boston. She has been on the management faculty there since 1983.

Richard Mazer has been named senior partner and area director for Marketing Corp. of America (MCA), a $200-million marketing services and diversified business company based in Westport, Conn. Mazer joined MCA from the San Francisco office of Deloitte and Touche, where he was head of the Food Industry Mergers and Acquisition consulting practice. He had previously held positions at DHL Corp., Gelco Rail Services, and the Boston Consulting Group. He will continue to be based in San Francisco. . . . **Steve Finn** is now VP of Bytex Corp. in Southborough, Mass. He was formerly president and CEO of the firm.

Two classmates wrote to report on the publication of new books. . . . **Dave Kaye** co-wrote a new edition of a textbook on law, medicine, and forensic science. After that, he "spent much of May and June struggling up and skiing down various mountains and glaciers in Alaska and Washington." . . . In April, W.H. Freeman published **Mike Riordan**'s third book, *The Shadows of Creation: Dark Matter and the Structure of the Universe,* which he co-wrote with David Schramm ('67). Mike also writes that he moved to Washington, D.C., in December 1990, on leave from Stanford University, to take a position as staff scientist/assistant to the president of Universities Research Association, Inc., a consortium of 78 universities building the superconducting supercollider in Texas.

We wish everyone all the best for 1992. I hope that those we haven't heard from in a while have made a New Year's resolution to drop us a line!—**Gail** and **Mike Marcus,** co-secretaries, 8026 Cypress Grove Ln., Cabin John, MD 20818

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You folks have sent no pieces of paper this month for this journal, so I'll just have to improvise. I did speak with **Dave Musgrave,** who continues his stellar career in gas turbine engineering in Michigan. He is also involved with a venture that deals with a super-duper insulating material that he and his brother invented. This past summer I bumped into fellow Burton 4ther **Barry Eisenstat** at the MIT Museum shop in the MIT Student Center. Barry is happily employed as a dermatologist in New York.

Yours truly now does consulting work for the Bose Corp. in Framingham, where I regularly see vice-president for research **Joe Veranth,** who has been with Bose ever since graduating from MIT. At Bose I also see another former Burtonite, **Charles Bures,** who I am happy to say looks almost exactly like he did in 1969! It is amazing how many MIT grads per square meter there are on The Mountain in Framingham.

To end with yet another "commercial," I received a very nice note from world-class cold fusion skeptic, Dieter Britz of Aarhus University, Denmark, who said, "I think that your book is by far the best one on the subject; I say this despite being a skeptic. I think you went out of your way to be fair with both sides; in fact, I have rarely seen the skeptic point of view presented so clearly." That's much more than can be said for the other side. In late August, I filed a formal request for an investigation of probable scientific misconduct at MIT in connection with cold fusion experiments that were performed in the spring of 1989. The MIT News Office, which nowhere in its publications announced that I had resigned as chief science writer subsequently issued a statement that said in part: "They [the MIT scientist experimenters] have concluded that while the reaction termed cold fusion is scientifically interesting, it is not one that is valuable for them to pursue at this time. . . . Research into this phenomenon is low on their priority list at this point." "Scientifically interesting" and "low on their priority list" indeed! We shall see.—**Eugene F. Mallove,** secretary, 171 Woodhill, Hooksett Rd., Bow, NH 03304

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Please send news for this column to: **Greg** and **Karen Arenson,** secretaries, 125 W. 76th St., Apt. 2A, New York, NY 10023

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Please send news for this column to: **R. Hal Moorman,** secretary, P.O. Box 1808, Brenham, TX 77834

72 20th Reunion

On September 1, **S. Gail Thurmond** married Dr. Harry Schaffer in Memphis in the Anshei Sphard Beth El Emeth Synagogue, which was founded by Harry's grandfather. The two doctors Schaffer will continue to live in Memphis with Gail's three children, Robert, Sara, and Lara. Robert is in third grade, and the twins are in first. All three have become great competitive swimmers. Gail continues to enjoy her practice as a neurologist. Harry is an anesthesiologist who spends part of his time in a pain-management practice. . . . **Ken Kempson** reports that for the past year he has been the deputy associate chief counsel (technical) of the IRS. He mentions "regulations and other easy-to-understand guidance." He must have been kidding, or else he has not dealt with the part of the tax code I see! In May 1991, he and his wife Catharine added a daughter, Abigail, to their family, which includes Peter, 3, and twins Danny and Emily, 6. He still finds time to play ice hockey, slowly.

Bob Goodof completed his sixth Pan Mass Challenge in August, a 194-mile bike ride, from Sturbridge to Provincetown, Mass., to raise money for the Jimmy Fund. Through the years he has had fun and raised over $30,000 for the fund. In his spare time he is still an equities analyst at Eaton Vance Management, covering the chemical, environmental, and software/pc industries. As he says, "It still beats working, but [I] have branched into some personal ventures that are finally showing promise. It can't be midlife crisis—I've already had a few of those."

Nathanial Fisch has been appointed a professor of astrophysical sciences at Princeton, in addition to being a principal research scientist. He has been at the Princeton Plasma Physics Lab since 1978, when he started as a research associate. He holds six patents and has written many articles.

That's it for this month's news. By now you have probably all seen that our 20th Reunion will be held June 4-7 in Cambridge. We look forward to seeing many of you there. . . . For now I wish you a happy New Year. Please send us more news.—**Wendy Elaine Erb,** Co-secretary, 6001 Pelican Bay Blvd., Apt. 1003, Naples, FL 33963

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Peter Huber's newest book is entitled *Galileo's Revenge: Junk Science in the Courtroom.* Published by Basic Books, it is a follow-up to his 1988 book, *Liability.* Peter's new book discusses the acceptance of junk science into liability cases. Examples include the Audi "sudden acceleration" case and the Bendectin morning-sickness drug, both resulting in years of litigation. As you may know, Peter was formerly a clerk to Supreme Court Justice O'Connor and is a senior fellow of the Manhattan Institute.

William Marberg has been named VP of Air Traffic Control and Air Defense Programs for Unisys Corp.'s Electronic and Information Systems Group. . . . **Fred Gross** has been named executive director of development for the Rand Corp. in Santa Monica, Calif. Fred had been director of corporate development at MIT.

Keep up the good work, fellow classmates, and write!—**Robert M.O. Sutton, Sr.,** secretary, "Chapel Hill," 1302 Churchill Ct., Marshall, VA 22115

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Please send news for this column to: **Lionel Goulet,** secretary, 115 Albemarle Rd., Waltham, MA 02154-8133

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Two class notes with which to start the New Year: **Alan B. Lefkof,** formerly president of Grid Systems Corp. in Fremont, Calif., has become president of Farallon Computing Inc. of Emeryville, Calif.

I received a letter from **Kenneth J. Isaacson:** "In 1979, I graduated from Columbia Law School, and began as an associate at New York's Fried Frank Harris Shriver & Jacobson. The one good thing that came of my 19 months there was I met my wife Lesli, who was a paralegal there. In 1981, I began with a small mid-town New York firm, Garfunkel & Bloomfield, and became a partner there in 1986. In 1989, I finally tired of working in New York, and I moved my practice to Roseland, N.J., where I am now a partner in the firm of Greenberg Margolis. My practice is concentrated in commercial litigation.

"Lesli and I have three sons. Brandon will be 9 in October, Devon is 6, and Jared is 16 months. Haven't decided yet if we'll go for the girl.

"When we brought Brandon to visit MIT a few years ago, he had told us he never wanted to go to a 'sleep-away college.' But we stopped in for something to eat at Lobdell in the Student Center, and he saw a student loading up his tray in the cafeteria. . . . Lesli told him that since his mom and dad were at home, the student makes his own decisions and choices about what to eat. 'Sign me up!' Brandon exclaimed. New approach for picking a college, but at least he made the right choice.

"Finally, I've just begun a 3-year term on the Board of Governors of the MIT Alumni Center of New York." That's all folks—keep writing.—**Jennifer Gordon,** secretary, c/o Pennie & Edmonds, 1155 Ave. of the Americas, New York, NY 10036; or 18 Montgomery Place, Brooklyn, NY 11215

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Correction for October 1991 issue, p. MIT 15: The Class of '76 gift of $110,797 that was presented to MIT last June was the largest 15th reunion gift ever recorded at MIT.

Robert and **Judy** (nee **Leider**) "now have four children, Danny (2.5), Beck (5), Jenny (7), and Andy (9). We have just moved into our dream house, with a pool in the basement for Judy, and a recording studio for me (Robert). I (Robert) work full time for Harvard Community Health Plan (which assimilated my previous employer, RIGHA) and part-time as church organist/music director. Life is understandably hectic."

James Clark has been elected a director for the Computer Museum, the only museum of its kind so far in the U.S. and possibly the world. The museum is devoted to educating the public about computers and their impact on society. James is a vice-president in the high performance and fault tolerant systems area for AT&T Computer Systems in Morristown, N.J. He is responsible for product management, marketing, and development. He has had a major role in allying AT&T with Pyramid Technology and Tandem Computers for high performance, UNIX system-based computers, and fault-tolerant computers, respectively.

Your secretary is now marketing data communication services for an upstart rival to GE and British Telecom/Tymnet: US Telecom. US Telecom has turned this entire area into something I know a great deal about—a commodity market with commodity market strategies and pricing techniques. With my efforts, we should hopefully make a significant dent in the oligarchy the above two firms represent. So if you are looking for cut rate data communication services of all kinds, and especially EDI, give me a call.

And even if you are not in the market for cheaper data communications services, please do write, fax or call. We urgently need your news.—**Arthur J. Carp,** secretary, Quantalytics, Inc., 220 Henley Rd., Woodmere, NY 11598-2523, (516) 295-3632, fax: (516) 295-3230

77 15th Reunion

Please send news for this column to: **Ninamarie Maragioglio,** secretary, 8459 Yellow Leaf Court, Springfield, VA 22153

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Your class secretary and wife **Diane Curtis** were blessed with the birth of Lucas James Bidigare-Curtis on September 28. He's a beautiful kid. Mom and baby are doing great. Dad is popping vest buttons! This year has been quite bountiful (and incredibly exciting!) with the adoption of Danielle in March, the birth of Luke, and the building of a new house on our farm!

Class President **Milton Roye,** wife Gloria Lara, and their beautiful daughter Katherine visited us over the Labor Day weekend. Milt and Gloria have been fixing up their house in Bloomfield Hills, Mich., doing yard work (often basking in the glow of a 150-watt utility light!), and spending lots of time with Kathy. Milt was drafted to help us install a chain link fence in the back yard during their visit. His able assistance was very much appreciated.

Kathy (Hardis) Fraeman, husband Marty, and daughters Dora and Abigail have moved to a new house in Olney, Md. Kathy is still doing a lot of quilting using computer-aided design and template drafting.

Diane (Prignoli) Semmling sent along a picture of Bonnie Lynn Semmling who was born in February. She writes, "I just took two weeks from my busy schedule as Bonnie's mom, Bijou the cat's gatekeeper, and the principle tender of the Semmling tomato garden to serve my active duty with the Coast Guard Reserve. I mainly helped investigate oil spills with the Captain of the Port unit. Fortunately, no supertankers ran aground in the Bay Ridge flats while I was on duty." Diane and family are living in Piscataway, N.J.

Best wishes to all classmates for a peaceful and happy new year!—**Jim Bidigare,** 322 Central Ave., Newark, OH 43055, (614) 345-8582

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Slow news this month. **Ed Tarney** has been named technical project manager of tooling, a new position at Crucible Service Centers in Camillus, N.Y. His duties include marketing support through technical assistance and training, as well as product recommendations and quality analyses. Crucible Service Centers is a division of Crucible Materials Corporation, a metalworking company, of which Ed has been an employee since 1980. Best of luck, Ed! . . . That's all I've got.—**Sharon Lowenheim,** secretary, 98-30 67th Ave., Apt. 6E, Forest Hills, NY 11374

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Stephen McNamara sent a letter to bring us up to date on his activities. After working for Abcor as an engineer for a few years he decided to ruin his eyes by spending three years at the University of Connecticut School of Law. After receiving a JD in 1986 he moved to Fairfield, Conn., and now commutes to Stamford where he is a patent attorney. Stephen's practice involves a range of patent, copyright, and trademark issues including such "fun stuff" as T-shirt artwork and "Pop Rocks" patents as well as serious things like chemical process equipment and software. If you would like to talk with Stephen about patents, etc., call him at (203) 324-6155. On the personal side, Stephen and his wife, Kathleen (also an attorney) are the proud parents of Brendan Patrick. Stephen says "Brendan ought to be a WWF wrestling star—he has a terrific body slam and loves to demonstrate his hair grabbing, face pounding moves." . . . A 1991–1992 White House Fellowship has been awarded to **Joseph Broz** in recognition of his leadership, professional and intellectual achievements, and dedication to his community. He will serve one year as a special assistant to the Presidential Science Advisor in the Office of Science and Technology Policy. . . . The recent travels of **Ralph Vincinguerra** were reported by his wife Lori, '87. This year they traveled to France, Italy, England, and Holland. They are now working on their house.

I hope everyone had a safe and happy holiday. Please make it one of your new year's resolutions to send in your news.—**Kim Zaugg,** secretary, 2384 Leslie Circle, Ann Arbor, MI 48105, (313) 665-2365, vayda@erim.org

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I am sad to begin this month's report on a tragic note. I have received the following notice from Mrs. John Gallagher: "It is with great sadness and deep regret that I have to inform you of the death of our beloved daughter, **Jan L. Gallagher.** She was a practicing attorney and resided in Austin, Tex., since graduating from the University of Texas in 1984.

"On June 16, she was the victim of a violent crime and died three days later of a subdural hematoma. Both I and her sister Dr. Gallagher, M.D., were with her at the time all machines were stopped. "A beautiful memorial was held in Austin and was attended by her colleagues and judges. They tell me she was on the verge of a brilliant career as a defense attorney. Remember her as we always shall."

We, her classmates, shall remember Jan, and extend our deepest sympathy and condolences to her family. Let each of us, in our own lives and in our own ways, strive against senseless violence in our society.

The rest of this month's news is happier to relate. . . . *Big Wheel, Cont'd* . . . Last time we heard from **Steve Levin,** he had just entered marital bliss and was forging ahead with his composite-material bicycle frame company, Carbonframes, Inc. It seems that Steve got into the business in a somewhat unusual way: he met his partner Craig Calfee in a San Francisco park, where Craig was living out of his van. Well, the cycling world has taken notice. According to reports in Denver's *Rocky Mountain News* as well as the Associated Press (July 10, 1991), one of Steve's bikes was ridden in the Tour de France by three-time champion Greg LeMond.

Boulder and Better . . . **Jenny Devaud** notes that she is now doing research in the Department of Physics at the University of Colorado, using biological materials for applications in physics and materials science. Jenny's husband Tom McKinnon, PhD Course X, '89, is a new faculty member at the Colorado School of Mines in Golden. Their daughter Karen is now 3, and son Daniel is 5. Says Jenny, "Life is great—it's beautiful here and we love the outdoors."

All creatures great and small . . . **Kathryn Gropp** is trading Florida oranges for New York ivy. She successfully defended her PhD dissertation at the University of Florida in Gainesville, and had now started a residency in veterinary pathology at Cornell University.

In-Vest-ing in the Institute . . . Classmates in attendance at the 1991 Alumni/ae Leadership Conference last September included **Irene Dale, Chuck Markham, Rhonda Peck, Cynthia** and **Jon Peltier, Rob Schoenberger,** and yours truly. It was interesting to hear about, and get involved with, the Institute's present and future developments. The President's Ball was quite a "swinging" time.

My next report will be from an exciting new location. Stay tuned!—**Mike Gerardi,** secretary, 1250 S. Washington St., #807, Alexandria, VA 22314, (703) 548-8409

82 10th Reunion

Please send news for this column to: **Stephanie Pollack,** secretary, 25 Royce Rd., Newton, MA 02159

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No cards or letters this month. No news clippings from MIT. Not even a card from people writing down what they are doing while giving money. Despite these hazardous conditions, your secretary has been able to acquire one quality tidbit: **Chris Schneider** has announced his engagement to Cindi Branscum. Chris is a founder of Transpac Software in San Jose, and Cindi is studying nursing. They are planning a May 1992 wedding in the Redwood forest.

It's time for a lot of you to write in. If you are too bashful to write about yourself, then write about somebody else. Remember, don't let the truth get in the way of a good story.—**Jonathan Goldstein,** secretary, TA Associates, 45 Milk St., Boston, MA 02109

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Well folks, it is pretty slim pickings this month. **Jeff Yoon** is finally back from his three-week business trip (which lasted eight weeks) to Singapore, Thailand, and other points East. I on the other hand am off to glorious Syracuse, N.Y. If USAir does not fly there, why bother?

Capt. **Charles McLendon** should be around the Quantico, Va., area nowadays, Marine uniform and all. . . . The sole letter of the month is from **Kathy Takayama.** She received her doctorate in biochemistry in May and is now a postdoc fellow at the University of Wisconsin—Madison.

Pulling a couple of things off the electronic feed. **Malcolm Delaney** became a doctor of subatomic mish-mash and is now working for Intel on the West Coast. Or as Malcolm puts it: "Apparently I fell asleep while riding that train. I have left the lush corn fields of Illinois for the foothills of Northern California." . . . **Neil Savasta** is now a director of product development at an up-and-coming young company, Siren, in Menlo Park, Calif. Watch out for the IPO. —**Howard Reubenstein,** secretary, 28 Mitchell Grant Way, Bedford, MA 01730, (617) 275-0213 (home), e-mail: hbr@mitre.org

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The news was a little thin this past month, but **Mark Panarusky** saved us from the shutout. Mark is enjoying life at North Carolina State University where he is studying for a master's degree in integrated systems enginering. Over the summer he visited several fellow Phi Sigs to bring us the following update: New Yorker **David Fung** apparently finds Allentown, Pa., to be too "small town," and so he is busy racking up frequent flier miles with Air Products Corp. **Robert Walsh** hosted Mark and his wife in Ann Arbor, Mich., where Rob recently earned an MBA from the University of Michigan. **Lee Brown,** who recently appeared in the Class Notes column under the alias "Lee Brown" (oops!), bought a chainsaw to open up a magnificent hillside view shortly before Mark's visit. Lee and his wife gave a tour of San Francisco and nearby wine country.

Many of our classmates have access to electronic mail, so I plan to offer a new service. If you send me your e-mail address, I will publish it (assuming that you have given me explicit permission to do so). Also, I will send the currently compiled list of e-mail addresses to those who request it. Here is the first installment: **Jim Hutchinson,** hutch@ai.mit.edu; **Anita Killian,** amkillia@athena.mit.edu; **Anne Lavin,** lavin@athena.mit.edu; **Chun-Nip Lee,** clee@hilbert.math.nwu.edu; **David Libby,** LIBBY@mitvmc.mit.edu; **Dan Orange,** dano@cats.ucsc.edu; **Mark Panarusky,** mapanaru@eos.ncsu.edu; **Gary Sabot,** gary%think.com@ai.mit.edu; **Rodney Schmidt,** rodney@alrsysv.UUCP; **Albert Wang,** albertwa@garnet.berkeley.edu .

And as always, **Bill Messner,** secretary, 2234 Jefferson Ave., Berkeley, CA 94703, messner@cmlds6.berkeley.edu, (510) 845-8119

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Wow! Everyone must have been burnt out from the reunion. I received only one post card this month. Bad news. Because when Mary doesn't receive any news, what does Mary do? She goes to the Alumni/ae listing (which is probably out of date by now). Oh well, in deference to those of you in the middle of the alphabet, I'll start with the K's.

Costa Kokoropoulos gets to go first since he actually wrote. Costa just recently moved to New York to start his residency in anesthesiology at SUNY in Brooklyn. Costa offers an invite to anyone in the Brooklyn area to look him up; he's the only Kokoropoulos in the book. . . . **Derek Barkey** is doing structural analysis for Douglas Aircraft Co.'s advanced design division in Long Beach, Calif. He spends his time cooking and camping with his wife Kelly.

On to the alumni/ae listing. (It's dated Sept. 1990 so if it's out of date, write me!) **Marios Kagarlis** is a grad student at the University of Penn in the physics department. . . . **Yona Kaplan** is a systems engineer at EDS in Troy, Mich.

Michael Kardos is a grad student at Stanford University. . . . **Robert Kassel** is a grad student at MIT. . . . **Craig Katz** is a producer at the Mutual Broadcasting System in Arlington, Va. . . . **Robert Katz** is at the University of North Carolina at Chapel Hill. . . . **Philip Keenan** is a grad student at the University of Chicago in the Department of Mathematics. . . . **Kathleen Kelly** is at the Boston University School of Medicine. . . . **Charlotte Kemp** is a woodworker in Jamaica Plain, Mass. . . . **Lori Kiesow Birkholz** is a development engineer at Honeywell Inc. in Lexington, Mass. . . . **Annabelle Kim** is a graduate

student at MIT as is **Edward Kim. Hung Kim** is a resident at Baylor College of Medicine. . . . **Jisu Kim** is the director of research and engineering at Tritec International Corp. in New York, N.Y.

Yul Kim is at the University of Wisconsin-Madison in the Department of Computer Science. . . . **Janette Kiso** is at the Dana Farber Cancer Institute in Boston, Mass. . . . **James Klaiber** is a member of the technical staff at AT&T Bell Labs in Whippany, N.J. . . . **Bryan Knight** is the chairman of the Math Department at the American Renaissance School in White Plains, N.Y. . . . **Kenneth Koblan** is at Johns Hopkins University in the Biology Department. . . . **David Koch** is a naval aviator. . . . **Todd Koelling** works for Intel Corp. in Folsom, Calif. . . . **Matt Kohn** is at Rennsalaer Polytech Institute in the Geology Department. . . . **Paul Kolosick** is at the University of Wisconsin-Madison in the Department of Chemical Engineering. . . . **Aya Konishi** is at Tufts University Fletcher School. . . . **Harvey Koselka** works for Design Continuum in Boston, Mass. . . . **Steven Kossar** is the president of Matt Terass Associates in New Haven, Conn. . . . **Michael Kraft** is an engineer for GE in Lynn, Mass.

David Kranzler works for Rolm Corp. in Santa Clara, Calif. . . . **Kenneth Kreider** is an interim-minister for the Church of Christ in Lexington, Mass. . . . **Bruce Kristal** is a grad student at Harvard School of Public Health. . . . **Laura Krusinski** is a junior geotechnical engineer for the Commonwealth of Massachusetts. . . . **Vikram Kuriyan** is at Harvard Business School. . . . **Robert Kusner** is a graduate assistant at CWRU in Cleveland, Ohio. . . . **Robert Kwon** is at Procter & Gamble Far East in Osaka, Japan.

Please write!—**Mary C. Engebreth,** secretary, 1805 Manhattan Ave., Hermosa Beach, CA 90254, (213) 376-8094

87 5th Reunion

Our 5th-year reunion is fast approaching! Think about it, almost five years have gone by and you haven't written one letter to your class secretary. Don't wait one moment longer—the fate of the universe may depend on you.

I have just received my first "international" letter in months. **Victor Guzman** writes, "I have been working for over a year for Diadema Mfg., which is involved in post-consumer plastic recycling and operates in Mexico on a national basis. I've been living in Cordoba, a cute little coffee growers' town south of Mexico City." Victor asked me to say hi! to the following '87ers: **Hal (Halius) Cohen, Farzan Riza, Steve Mackler, Rod Moreno, Felix Partow, Robert Frank, Jane Yang, Lynn Schlactus, Susan Fields, Stacy Weinstein, Ed Savard, Mike Schoen, Jack Penny, Jasper Otterbeck, Andrea Ghez, Brian Kimmel, Reed Steinmetz, Leo Monzini, Julia Gessner, Betsy Parker, Nancy Chang, Bashar Zeitoon, Maria Tsiakkas, Simon Kassianides, Jeff Klohr, Emilio Lopez, Mario Girasa, Doug Golding, Jose Kabana, Martha Beverage, Mary Maliniak, John Martel, Linda Marinilli, T.C. Lau, Dana Takaki, Amy Austin, Mimi Bloom, Betsy O'Neil, Terry Flood, Peter Lukasc, Susan Noe,** and **Nikoleta Fouska.** (Now, all these people have to write to me and tell me what they're doing! If they don't strange things will start happening.)

John Fearnside wrote to the *Technology Review* office from Seattle, Wash.: "After nearly eight years in Boston I have finally decided to bag the East Coast to take a job as a software engineer at Aldus Corp. in Seattle. It's true; the weather sucks. Don't move here."

I spent last weekend in Boston at the MIT Alumni/ae Leadership Conference. **Charles Coleman,** our fearless president, was at the Class Officer Workshop. He told me that he's working on his "gradual" degree (PhD) in electrical engineering at University of California, Berkeley. . . . While in Boston, I also saw **Dan Kennedy, Lowell Kim,** and **Mike Foley,** all on their way to the MIT football game. **Bob Vokes** was on his way to London on business, after a trip to Michigan to visit **Jordan Levin,** so we missed him.

For the U.S. Open, **Jay Cohen** has a small get-together to celebrate Jimmy Connor's comeback. **Stan Oda, Chris Young, Bill Von Novak, Gene Cohen, Andrea Stemple, Rob Swiston, Greer Tan, Lisa Guttroff,** Hal Cohen, **Cynthia Espersen Tronco, Jim Koenig,** and myself were there. The hors d'oeuvres were knishes from Buzzy's. Rob Swiston and Greer Tan, and Gene Cohen and Andrea Stemple are engaged to be married. Congratulations!

I am sad to say that a classmate, **Joseph Han-Joon Shinn,** passed away July 26 when struck by a car in Barcelona, Spain, while on vacation. Joseph was a senior consultant with SQL Solutions, Inc., of Burlington and lived in Cambridge. He leaves his parents, Jeong Ha and Chun Shick (Ahn) Shinn, and a brother, Samuel H. Their address is 1500 Center Ave., Fort Lee, NJ 07024.

Please excuse my dramatic opening, but I'm tired of making up stories. (Just kidding!) Call or write, or send e-mail or a FAX to me at—**Stephanie Levin,** secretary, 159 W. 80th St., Apt. 1D, New York, NY 10024, mikki.mitvmc.mit.edu, (212) 595-3172, fax: (212) 983-9107

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Please send news for this column to: **Grace Ma,** secretary, 545 1st Ave., #7R, New York, NY 10016

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Happy New Year! I hope everyone is having an enjoyable holiday season. I'm going to make a plea for news. I haven't been getting much (any) U.S. mail for the past few months and want to encourage those of you without e-mail accounts to drop a postcard or a letter. All I can say is thank goodness for e-mail, or we'd have no column! But the e-mail has been thinning out recently, too.

Teri Centner moved into her own two bedroom condo in September. The condo is right across the street from **Mark Moss's** apartment complex, so Teri and her roommate will probably have Mark and his roommate over for dinner all the time, and vice versa. (Mark doesn't cook, but his roommate is a budding chef.) Teri will be living with another lieutenant who is a nurse at the medical center on base. Mark has been taking grad classes and will be reassigned on December 17; he is likely to be in the United States since his last assignment was in Korea.

Teri also writes that **B.J. Bergevin** is now at Wright Patterson AFB to get a master's degree at AFIT (Air Force Institute of Technology). Teri ran into him at the officers club on August 24, which is the same day that **Robert Newkirk, Scott Tennant,** and Teri were promoted to first lieutenant. During September, Teri took a trip to the University of Maryland, where she saw **Joe Orso** and **Dave Fleming,** who are working toward master's degrees there.

Dan Teal visited Teri in July, and they got a chance to go drinking and catch up on ROTC gossip. . . . **Cristina Vilella** is still in Merced, Calif. She has asked for an overseas assignment and will be reassigned soon. . . . **Jolly Chen** spent a year working for HP after his VI-A there, and is now going for a PhD in computer science at Berkeley. . . . **Tomas Saulys** wrote about some of his summer adventures. Tomas made it whitewater rafting, and twice tried to go to Lithuania. Unfortunately, due to the volatile situation there in the past year, he was forced to cancel his plans. He is planning to go sometime soon, since the situation there has changed drastically. Tomas also writes that **Gary Curwin** is back at Harvard Law School after working in a law firm in Newark for the summer. . . . **John Santoro** is still working for Arthur Andersen in northern New Jersey. . . . **Ed Flynn** still works for the Foxboro Co. Ed spent the summer in Houston working for them, but is now back in Foxboro, Mass. . . . **Jennifer Lund** is at the University of Michigan, and she reports that she is looking around for a thesis topic.

John Araki and **Andy Barrows** are in the aero/astro program at MIT. Andy recently moved near Inman Square where he is living with Jack Kotovsky, '90, and Don Woodlock, '88. . . . **Karen Gold** was married this past summer. She works at IDX, where Don is a programming supervisor. . . . **Matt Rita** is studying at Cornell Law School. . . . **Eric Tang** recently moved out to California, where he works at Electronics for Imaging. . . . **Alan Davidson** is back at MIT in the Technology and Policy Program after spending a year in D.C. consulting for NASA's Space Station Program. Alan spent this past summer working in the District for the Office of Technology Assesment. Alan will be finishing this year.

Lori Tsuruda volunteers for an organization that has her totally psyched, City Year, which is the nation's first urban service corps which brings together youths (17 to 22 years old) from every race and background. Corps members help the needy on a full-time basis, building soup kitchens, restoring urban gardens, running after-school programs, etc., quite similar to Alpha Phi Omega projects. Lori recently attended the 1991–92 City Year corps opening day ceremonies, and was deeply moved by the wonderful pledge these young people made. . . . **Tom Chou** is in the physics department at Harvard, and attended a physics seminar in D.C., where he also had the chance to visit **Jason Chiu,** who is currently a Howard Hughes research scholar at NIH in Bethesda.

Classes at MIT have just started, and it's gotten extremely busy again. I've been looking around for a good thesis topic. I also got a partial harp scholarship from the music department, and I'll be making my orchestral debut as second harpist in the MIT Symphony for Debussy's "Nocturnes." Dawn Watkins, '92, is the principle harpist. Please write, or call, now that my new number is listed!—**Henry Houh,** secretary, 4 Ames St., Cambridge, MA 02142, (617) 225-6680, e-mail: tripleh@athena.mit.edu or henryhouh@mit.edu

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Daniel Klain and **Andrew Sutherland** were recently named members of the American Mathematical Society. Congratulations!. . . **Irene Kuo** writes that she is currently in medical school at UCSF. In May, Irene ran the 12-kilometer Bay to Breakers race with **Laura Scolnick, Karen Fu,** and 10,000 others. During the summer, Irene spent eight weeks in Japan working at a biotech company and hanging out with **Chris Gittins** and Shige Kubota, '89.

Jae Young Kim is also in California. He's been working for the Stanford Linear Accelerator Center, and in his spare time he's been playing keyboards in a heavy metal vaudeville band. . . . Out in Sigonella, Italy, we find **Maia Hansen,** who has recently reported for duty at the Naval Air Station in Italy.

That's all for this time—not too much news was sent in. What did everyone do for the holidays? Happy New Year! Please write to my new address: **Ning Peng,** secretary, 355 S. End Ave., Apt. 27G, New York, NY 10280

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Welcome to our class notes! As you may notice, I am the new class secretary. Your other class officers are: **Sharra Davidson,** president; **Sue Perrin,** vice-president; **Laura Moore,** treasurer; **Garrett Love,** class agent; and **Brian Katz** and **Anthia Chen** both serve as members-at-large. We'll hold these positions until our 5th reunion. And now, the news:

In August, **E. Jay Berkenbilt** and **Lisa Paradis**

were married. Lisa is working at Engineering Research Associates in Vienna, Va. . . . **Amy Anderson** married Andrew Chang, '87, on June 30. They will be living in Arlington, Mass., while Amy prepares for a PhD in biophysics at Harvard.

Last summer, **Monica McConnell** was married in the MIT chapel. . . . **Joanne Hopmeyer** married Steve Danner, '90, in Boston. Joanne is now studying chemical engineering at Georgia Tech. . . . **Chuck Benson** was married to Katherine Rickard on July 6 in Washington. Congratulations and best wishes to you all!

Kelly McDonald is working at SRA Corp., a group consulting firm with U.S. governmental agencies as the primary clients. She hopes to meet many other MIT alums in and around Washington, D.C. After graduation she planned a roundtrip sailing expedition to Bermuda. . . . Other international voyagers included **Tom Cole, Alex Min, Jeff Myjak, Roger Knapp, Dylan Cors, Mike Plusch, Dave Haldeman, Chuck Sindelar,** and **Steve Tucker,** who rowed in the 152nd Henley Royal Regatta in England.

Cheryl Klepser is continuing in the materials science and engineering master's co-op program; she'll be back on MIT's campus in spring '92. . . . **Renee Mong** returned to Cambridge to begin a master's program with the Space Power and Propulsion Laboratory in the aero/astro department. . . . **Ted Theodosopoulos** is doing graduate work at the Operations Research Center. . . . **Max Morris** has started the *Analyst*, a newspaper at MIT that includes debates about political correctness. . . . **Dan McMahill** is doing graduate work and is a TA for 6.101. . . . Other classmates furthering their studies at MIT include **Mauricio Roman, David Oh, Esteban Torres,** and **Hoang-Doan Vo.**

Kodak is lucky enough to employ two of our classmates: **John Stephens** and **Lisa Misterka.** . . . **Josh Ertischek** and **Rachael Batcheler** are both working for Arco in Alaska. . . . **Heidi Miracle** is studying operations research at Georgia Tech. . . . **Prabhat Mehta** is studying law at Yale; **Alexander Denner** is at Yale as a University Fellow studying fluid mechanics and chaos. Both **David Mitchell** and **Jamie Negle** are at Yale to study physics; Jamie is playing on the physics intramural volleyball team.

Kristine Au Yeung is working with product design engineers at Ford Motor Co. in the plastics division. . . . **Deb Tuscano** and **Debbie Moynihan** are also in Michigan with Ford. . . . **Laura Moore** is working for the Navy in the Phillipines ("if there are still bases there," she adds). . . . **Bill Moliski** is somewhere on a Navy submarine (I could tell you, but then. . .). . . . **Shawn Mastrian** is living and working in Providence for Leviton. . . . **Danielle Ford** is attending nearby Brown University to pursue a PhD in geochemistry. . . . **Ken Shimberg** is working in corporate financial services at J.P. Morgan. . . .Last September, Ken, **Cristina Chen,** and **Paul Antico** met at the apartment Cristina shares with **Sabrina Tellalian** before spending an evening in Greenwich Village. Paul works in Boston for Fidelity Investments, while Cristina and Sabrina work in New York at First Boston and Merrill Lynch, respectively. . . . **Jason Sherman** lives in Seattle where, with his fiancé Tricia Anderson (Wellesley '91), he is planning their wedding and with his father is doing controls engineering. . . . **Darby-Annette Hailes** worked in California for the summer before beginning a Mormon mission for a year and a half.

Andrew Frazier and **Leo Creger** began Navy Supply Officer school in Georgia on August 12. Leo plans on being stationed in the San Francisco Bay area soon on either a surface ship or a fast attack submarine. . . . In October, **Jeffrey Drake** began a four-month Engineer Officer Basic Course at Fort Leonard Wood, Md. . . . **Belinda Schmolke** has returned to her home country, Zimbabwe, to work in a computer company. . . . Both **Dawn Mitzner** and **Susan Jackson** are attending Johns Hopkins Medical School.

James Scanlin is working for Bose in Massachusetts. . . . **Marc Wisnudel** is pursuing a PhD in the chemical engineering department at Northwestern University. He writes, "When not playing with polymers, I will be swimming in Lake Michigan." . . . **Jerry Sasser** was commissioned as a second lieutenant in the Air Force before he headed south to Auburn University to pursue a PhD in physics. . . . **Emil Dabora** is still studying economics—but now he's at Harvard. . . . **Whitney Edminster, Shlomit Halachmi,** and **Aaron Sodickson** are in the Harvard–MIT HST program working toward MD degrees. Aaron returned from Japan with the 2.70 contest before assuming his new duties as the floor tutor for Burton Four. He also represents one half of the first pair of brothers ever to go through the HST program. . . . **Charles Quentin Davis** is studying with the Harvard-MIT medical engineering PhD program and the MIT electrical engineering graduate schools.

Sharra Davidson finished working at the White House for the President's Deputy Assistant for Political Affairs. She is "now working for a private firm that will be handling the finances for an upcoming presidential campaign." She passed along news about several other classmates. . . . **Chris Masalsky** is living on Cape Cod and working for the May Institute, mostly with autistic adults. He was recently engaged to Amy Franz (Wellesley '91). . . . **Ed Munnich** is teaching mathematics and social studies in Long Beach, Calif. . . . To help develop his lesson plans, he sometimes calls his younger sister at night to find out what she did in class that day. **Kris Newton** teaches physics at Cambridge Rindge and Latin. . . **Jennifer Uhle** is working for the Nuclear Regulatory Commission in Washington, D.C., while pursuing a PhD in nuclear engineering at MIT. She spent the summer at Los Alamos. . . . **Alan Beale** is working for Professor Grodzins at MIT. He and Andy Parsons are sharing a house in Somerville with many other Theta Xi's. Sharra saw Andy in the student center, "running around as usual with his beeper around his waist, still working 50 jobs and studying at the same time!"

Paul Marinace is working for an architectural firm in New Hampshire. . . . **David Rothstein** works in Houston at the Baylor College of Medicine in their division of neuroscience. . . . **Francisco Donez** participates in a teaching program in South America. . . . **Warren Brown** designs power plant controllers when he's working; when he's playing, he's with MIT rugby. . . . **Lisa Marzullo** works for Martin Marietta Aero and Naval in Baltimore in their new operations development program while attending graduate school to get a master's in aeronautics. . . . **Lon van Geloven** has a TA position in the mechanical engineering program while he studies at Stanford. . . . **Tassos Pittas** is studying at Stanford Medical School; **Roy Mendoza** is there to study aero/astro. . . . **Lauralee Grizzaffi** is studying in Stanford's mechanical engineering master's program, and **Jennifer King** is studying biology.

Susanne Perutz is finishing a master's at IBM in New York. She plans a 1992 entrance into Cornell's Department of Materials Science and Engineering. . . . **Jack Cheng** worked at Los Alamos National Laboratory last summer; he's now in graduate study at the University of Maryland. . . . **Jack Scheuer** drove across the country to begin a job at Apple Computer in Fremont, Calif. . . **Glenn Eswein** is finishing a 6A program at Comsat in Washington, D.C. . . . **Praveen Saxena** is studying mechanical engineering at Lehigh; he and James Lombara ,'90, share an apartment above a bar. . . . In August, **Melissa Chang** began attending a military intelligence course at Fort Hauchuca, Ariz., after working ROTC advanced camp in Fort Lewis, Wash.

That's all the space I'll use this month; check this spot next month for more news from the rest of the class. I look forward to hearing from you.—**Andrew Strehle,** secretary, 12 Commonwealth Court, #10, Brighton, MA 02135, (617) 232-2261

COURSE NEWS

I CIVIL ENGINEERING

James V. Hamel, SM '66, sends word from Monroeville, Pa.: "I was recently promoted to second degree black belt in Tang Soo Do (Korean karate). When not practicing martial arts, I have been consulting on dam projects across the U.S. and investigating failure of a petroleum product pipeline associated with a landslide near Pittsburgh."... **Jorge Diaz Padilla**, PhD '74, chair of the MIT Enterprise Forum of Mexico, has been appointed as a board member of the Alumni/ae Association in representation of District 9 which includes Mexico, West Canada, and twelve States of Central U.S. As president of Systec, Inc., a consulting firm which specializes in project management and troubleshooting for foreign companies who do business in Mexico, he has been very active in discussions related to the Trilateral Free Trade Agreement that is currently being negotiated between Mexico, Canada, and the U.S.... **Frederick P. Gross**, '73, SM '75, ENE '75, has been appointed executive director of development at RAND in Santa Monica, Calif. Gross had been serving as director of corporate development at MIT. According to a Rand news release, "During his five-year-stint in that post, he developed and implemented strategies for a successful major capital campaign and established close ties between alumni and corporate fundraising efforts."

Ignacio Rodriguez-Iturbe, has been awarded the Venzuelan Science Prize for 1991. This prize, given to one person annually, is the highest scientific distinction given in Venezuela. Rodriguez-Iturbe holds a joint appointment in the Instituto Internacional de Estudios Avanzados at Caracus, and the MIT Department of Civil Engineering in the Ralph M. Parsons Lab where he is a senior lecturer. The prize is awarded for "his contributions to Hydrological Sciences where special mention was given to his pioneering work in the geomorphologic structure of the drainage network and its relation to hydrologic response; the design of rainfall networks in time and space; the nonlinear dynamics of soil moisture at continental scales; and in probabilistic models for rainfall simulation." **Brian R. Brenner**, '82, SM '84, senior structural engineer of Parsons Brinckerhoff Quade and Douglas, Inc., has been named Young Engineer of the Year by the Metro Chapter of the Massachusetts Society of Professional Engineers. The award is made annually to an engineer under 35 years of age in recognition of that person's professional, civic, and scholastic accomplishments. Brenner is a lead tunnel designer for the depressed section of Boston's Central Artery project and has been appointed design engineer for the largest contract on the project. He coordinates structural design and all elements of tunnel design. In this position, he supervises a group of eight engineers and drafters. Brenner, a computer buff, also serves as the Central Artery engineering CADD/computer supervisor.

B.R. Brenner

David W. Cravens, '53, holder of the Eunice and James L. West Chair of American Enterprise Studies at Texas Christian University, has received the Chancellor's Award for Distinguished Research and Creative Activity for 1991. Endowed by an anonymous TCU alumni couple, the honor includes a $12,000 check in recognition of outstanding ability and accomplishment to cover expenses the awardee feels will most enhance his contributions as a scholar... **Sarah E. Slaughter**, '82, SM '87, PhD '91, has been named an assistant professor in the Department of Civil Engineering at Lehigh University in Bethlehem, Pa. Slaughter specializes in construction management, and engineering systems management and innovation.

II MECHANICAL ENGINEERING

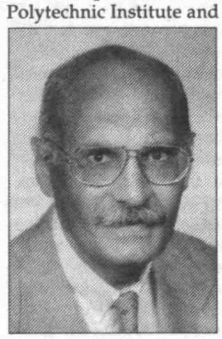
Juan J. Manzano-Ruiz, SM '77, ME '77, PhD '81, writes: "I am reporting from England where I am spending a year as a visiting professor, doing research work at the University of Bristol under the auspices of a Fellowship from the Economic European Community. My experimental work is focused on drag reduction of turbulent fluid flows through the use of polymer melts, as well as on the structure of turbulence."... **Samuel Tennant**, '50, president of the Aerospace Corp., has been named a Jimmy Doolittle Fellow by the Aerospace Education Foundation of the Air Force Association. Tennant, who has been president of Aerospace since 1987, was scheduled to retire in December. According to a company news release, "The award is given to those whose careers match the profile of Lieutenant General James Doolittle's, reflecting participation in and contributions to government advisory boards, nationally recognized achievements, and involvement in national security work. Tennant has demonstrated dedication to the national space effort over his entire career. Before coming to Aerospace in 1961, he directed studies defining the Titan II system at TRW Systems. At Aerospace he served as VP and general manager of Advanced Orbital Systems Division and group VP of both the Programs and Development groups. He is currently a member of the Defense Science Board and a director of the Los Angeles World Affairs Council, and he has been a consultant to the Los Alamos National Laboratories. Tennant has been active in the field of orthopedic research and is the co-inventer of the Tavernetti-Tennant total knee prosthesis."... **Mont Hubbard**, SM '65, professor of engineering at the University of California at Davis, and **Jechin Han**, ScD '77, professor of mechanical engineering at Texas A&M University, have been named Fellows of ASME. The Fellow grade is conferred upon a member with at least 10 years active engineering practice who has made significant contributions to the field.... **Peter W. Huber**, '73, SM '74, PhD '76, author of *Liability*, has had another book published, *Galileo's Revenge: Junk Science in the Courtroom* (Basic Books, 1991). In the book Huber, one of the country's leading experts on liability law, "offers a scathing indictment of how legions of case-hardened lawyers have successfully shifted the law from the rule of fact, using professional 'expert' witnesses to press unsubstantiated claims on the basis of what nobody but a lawyer would call science," according to a book jacket blurb.

S.M. Tennant

III MATERIALS SCIENCE AND ENGINEERING

Harold Fairbanks, SM '40, writes: "I am a professor emeritus at West Virginia University and I have moved to Mesa, Ariz., where I'm a consultant in ultrasonic treatment for mineral recovery. I'm also interested in solar applications and I volunteer for the State of Arizona Mining and Mineral Museum."... **Steven J. Berman**, SM '73, sends word from Cherry Hill, N.J.: "I have sold my consulting practice to Hay Group to become a work-force variable compensation practice manager for Hay Management Consultants headquartered in Philadelphia."... **Lloyd H. Hihara**, SM '85, PhD '89, reports: "I am assistant professor of mechanical engineering at the University of Hawaii at Manoa. My research interest is corrosion of metal-matrix composites. I am also a faculty advisor for Pi Tau Sigma, the mechanical engineering honor society."

Diran Apelian, ScD '73, provost of Worcester Polytechnic Institute and Howmet Professor of Engineering, writes that he "is the recipient of the Champion H. Mathewson Gold Metal of TMS-AIME for 1992. The Mathewson Gold Medal is presented to an author of a series of papers published in *Metallurgical Transactions* which is considered to be the most notable contribution to metallurgical science during the period under review."... **Richard P. Simmons**, '53, chair of the board at Allegheny Ludlum Corp. in Pittsburgh, has been selected as a 1991 recipient of the ASM Medal for the Advancement of Research. Established in 1943, this medal honors "an executive of an organization who is active in the production, fabrication, or use of materials and has consistently sponsored research or development in addition to substantially advancing the arts and sciences related to metals and other materials." Simmons was cited for "exemplary leadership in sponsoring research for stainless and specialty steel industries and for international issues."



D. Apelian

George J. Bair, ScD '36, of West Palm Beach, Fla., died on July 31, 1991. He was a retired director of technical staff services for Corning, Inc. Blair was a Fellow at Mellon Institute and past president of the American Ceramic Society. A

member of the executive committees of the International Glass Congress, he also served on several committees of the National Academy of Science and the National Bureau of Standards. During World War II, he received a citation from the U.S. Navy for developing a glass substitute for mica.

IV ARCHITECTURE

Timothy Mansfield, MAR '90, writes: "Upon graduation, my wife Kathryn and I spent five glorious weeks in Italy! When I returned home in July I began working with the firm H.N.T.B. Architects as a project architect. So far we have been quite busy—amazing for this economy! Kathryn and I are well and living in Cambridge and expecting our first child in February! We send our best to all.". . . **Alex L. Seid**, MAA '74, reports: "Last summer I spent doing research in Japan, Korea, Thailand, and Hong Kong on public investment on mega-capital projects. I visited with **Philippe Annez**, SM '71, PhD '81(XI), who is regional director for the World Bank. I didn't get a chance to see **Pia Ocharoen**, MAA '77. I am being transferred to the Aviation Department at Logan Airport and I am finishing my MBA at Boston University this coming May.". . . Sasaki Associates, Inc., of Watertown, Mass., has promoted **Andrew Garvin**, MAR '89, from architect to associate. The 300-person firm has offices in seven U.S. metropolitan areas and provides services in planning, architecture, landscape architecture, urban design, transportation planning, civil engineering, environmental services, interior design, and graphic design.

The Alumni/ae Association has been notified that **David D. Longmaid**, MCP '50, of West Chester, Pa., died on August 4, 1991. He was a senior urban planner for the Environmental Protection Agency in Philadelphia. There was no further information provided.

V CHEMISTRY

Richard B. Kurzel, PhD '71, writes: "I have left the faculty of the St. Louis University School of Medicine and have joined the faculty of the UCLA School of Medicine where I am assistant professor and associate director of the Division of Maternal-Fetal-Medicine in the Department of Ob/Gyn of the newest L.A. County hospital, the Olive View Medical Center. I am currently serving on the Perinatal Advisory Committee of the Department of Health Services for Los Angeles County. In January 1992 I will be presenting two papers at the annual Society of Perinatal Obstetricians Meeting. I live in Simi Valley, Calif., with my wife, Kathy, and two sons, Mark and Carl.". . . **Elwood P. Blanchard, Jr.**, PhD '59, vice-chair of the Du Pont Co. in Wilmington, Del., has been named chair of Du Pont Canada, Inc., in Toronto.

Sumner B. Sweetser, SM '34, ScD '37, of Farmington, Conn., died on August 11, 1991. Sweetser, a retired research chemist who worked for Exxon for 40 years, was active in the Red Cross. . . . The Alumni/ae Association has been notified that **Abner C. Hopkins, Jr.**, SM '33, of Fort Meyers, Fla., died on February 22, 1991. There was no further information provided.

VI ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

Lori Vinciguerra (Antis), SM '87, writes: "**Ralph Vinciguerra**, '80, SM '82, PhD '88, and I have been busy working on our house. We did manage a short break to travel Europe (France, Italy, England, and Holland). We were happy to see fellow MITers Maurice G. and Maurice B. on our journey.". . . **Adolph C. Hugin**, SM '30, sent us a long letter from North Springfield, Va., of which this is an excerpt: "Sunday, August 11, 1991, at the end of the annual 'crab-fest' meeting of the St. Vincent de Paul Society Prince George's County, Md., District Council, the council president asked that Dr. Adolph C. Hugin please step forward as the council had decided that he 'has been around long enough' and should be 'read out' by the Society! So, from the assembled members, 'Doc,' as the designee is known by those who know the 84-year old former law school professor, arose and stepped forward apprehensively. The president then came around the podium with a box-like object in his hands and announced that the council had decided to present to 'Doc' the 'Frederic Ozanam Top Hat Award,' the top St. Vincent de Paul Society award in America to a Vicentian for long and exemplary service in carrying out the charitable aims of the society. This is the fifth time the award has been made in the Washington Archdiocesan Council area.". . . **Miles Posen**, SM '84, sends word from Chicago: "I am currently the director of R&D at Beltone Electronics. Beltone is one of the leading manufacturers of hearing aids and hearing test equipment."

Kevin Parker, SM '78, PhD '81, is an associate professor of radiology at the University of Rochester's Medical Center. He and another associate professor are working on "bubbicles"—tiny particles filled with microscopic-sized bubbles—for use as agents which boost the contrast in ultrasound images. Using ultrasound to diagnose liver tumors and circulatory problems is cheaper and safer than using CT scans or X-rays. . . . **Murray B. Sachs**, '62, SM '64, PhD '66, a specialist in hearing research at Johns Hopkins, is the new director of the School of Medicine's Department of Biomedical Engineering, "a program rated number one in the nation by two independent surveys," according to a Hopkins news release. "Educated in both engineering and neuroscience, Sachs joined the Hopkins biomedical engineering faculty in 1970 and since then, his interdisciplinary contributions also have earned him appointments as professor in neuroscience, otolaryngology, and more recently as director of the newly formed Johns Hopkins Center for Hearing and Balance." Sach's contributions have been in the area of hearing sciences, aimed at understanding hearing loss or impairment.

M.B. Sachs

Guy L. Steele, Jr., SM '77, PhD '80, has drawn the cartoons and written the foreward to *The New Hacker's Dictionary* (MIT Press, 1991). The dictionary, edited by Eric Raymond, is "dedicated to all the hackers of the future, human and otherwise. You'll know who you are.". . . **J. Francis Reintjes**, MIT Course VI professor emeritus and senior lecturer, has written *Numerical Control: Making a New Technology* (Oxford University Press, 1991). According to the book jacket, "this remarkable account describes the development of the principal method used in the automatic control of machine tools by computer means. The technique, known as numerical control, was pioneered and demonstrated at MIT during two decades of exciting work, from 1950 to 1970. It has evolved from a futuristic concept to mass-production reality, and today it is essential for modern methods of industrial manufacturing."

Terry P. Orlando, Course VI associate professor, and **Kevin Delin**, '83, SM '85, EE '88, Course VI instructor, have co-written a textbook, *Foundations of Applied Superconductivity* (Addison-Wesley, 1991).

VI-A INTERNSHIP PROGRAM

This past summer found the Northeast plagued with long spells of hot, humid weather—with many near record-breaking days above 90° F. Perhaps in December, when this is published, we'll look back wistfully on those days—come winter and the receipt of our heating bills.

On one of those days, yours truly took a special excursion boat trip to Little Brewster Island, in outer Boston Harbor, for a visit to America's oldest lighthouse—Boston Light—lighted in 1716 and celebrating its 275th anniversary in September! With the current automation of all remaining active lighthouses on U.S. coasts, Congress has decreed that Boston Light will remain its historical self—a staffed facility—with two U.S. Coast Guard officers on duty on a two-week-on and one-week-off schedule.

I have my own personal interest in this special lighthouse. As a youngster, I spent many summers at my grandfather's house at Point Allerton, on the headland directly beside the then main shipping channel past Boston Light. Many freighters and huge ocean liners plied their way through this channel while leaving or entering the port of Boston. A thrilling sight in those days.

While on the subject, I understand that you people on the West Coast can visit the lighthouse at the entrance to San Francisco Bay. It has been taken over by a group which has arranged with the Coast Guard to maintain the light while allowing weekend bed and breakfast visits to provide revenue for its maintenance. Maybe the fog horn won't blow all night.

Meanwhile, back at the Institute, meetings are being held to firm up plans for the June 1992 celebration of the 75th anniversary of VI-A. A September "Save-the-Date" mailing from the Alumni/ae Office should have reached most all VI-A's. If not, please contact the VI-A office (617-253-4644) and let us know your current address. I've worked hard to establish an accurate VI-A database (over 3,000 graduates) and I know there are some discrepancies and omissions which need to be corrected. It is my desire not to leave anyone unnotified of this upcoming historical event.

Under "honors and awards" MIT has, again, captured the IEEE's Education Medal. The honor has gone to Professor **Hermann A. Haus**, ScD '54, for "creative contributions to education in electromagnetic fields and waves, and quantum electronics." During my tenure as VI-A director, Professor Haus served as VI-A faculty advisor to the AVCO/Everett Research Laboratory when that facility participated in the VI-A Program.

Other news about VI-A grads . . . **Edward C. Giaimo**, '74, SM '75, is currently consulting with a firm in Kendall Square, Cambridge. His home is still Bellevue, Wash. During one business trip east, in early September, his wife and year-old daughter accompanied him and they all came out to my home in Wellesley for an afternoon's visit. This was my first chance to become acquainted with them as I toured them through Wellesley College campus and the surburban New England countryside. . . . **Steven K. Ladd**, '81, SM '81, is now working here in the East and he joined me for lunch one day. Steve was married in July to **Anne E. Moroney**, '84. He has frequent contact with **James E. Mandry**, '81, SM '83, who recently stopped by the VI-A Office. . . . Back at the Institute as a graduate student working for a PhD is **Peter M. Osterberg**, '80, SM '80. Peter is a teaching assistant in 6.013 for the fall term. . . . **Paul R. Cosway**, '82, who has been with McKinsey & Co., stopped by. . . . **Owen L. Doyle**, '84, SM '84, has returned to the United States after being a volunteer teacher in Chad, Africa, and is married to a French woman.

Memoir from the Temple of Logic and Reason

The Idea Factory:
Learning to Think at MIT

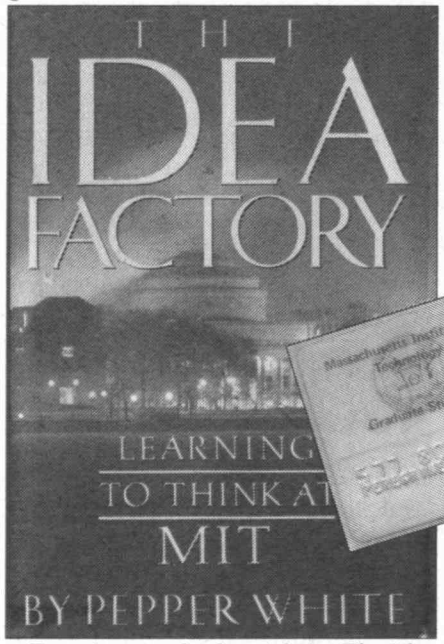
by Pepper White, SM '84
Dutton, $21.95

To non-initiates, MIT can seem a monolithic place variously inspiring envy, awe, fear, loathing, and admiration. To initiates—those who have survived the ordeal—the place evokes all those and more—pride, loneliness, passion, and synapse burnout, to name a few. And everyone's story is, naturally, a little different. *The Idea Factory: Learning to Think at MIT* is Pepper White's story.

White's view of the Institute is that of a master's candidate in mechanical engineering in the early 1980s. He was among the 50 percent of students to the left of the infamous bell curve, for whom class average becomes, if not an obsession, a constant yardstick and source of anxiety on which both funding and self-esteem often depend. He came to MIT with a bachelor's degree in environmental engineering from Johns Hopkins and a year's work in Belgium under his belt, and found himself having to paddle vigorously to keep up with the current. His is a tale of realizing his limitations as well as his capacity to learn and to rise to challenges, and he tells it with a sometimes engaging blend of humility and pride.

White's chronological narrative begins the day he learns of his acceptance to MIT. Through a blend of reflection, dialogue, and technical descriptions—complete with illustrations and equations—he wends his way through finding support and a desk, rebuilding the Sloan Automotive Laboratory's rapid compression machine, a semester on academic probation, collaboration with Doc Edgerton, and a stint as Senior House tutor, finally reaching those all-decisive PhD qualifying exams. And along the way, he writes, "I was taught objective, rational, logical modes of thinking. I learned intuitive thinking by doing research and by solving problems. And my heart was educated, for good or bad. . . . MIT really did make me smarter—which means that anyone can become smarter, by learning how to think."

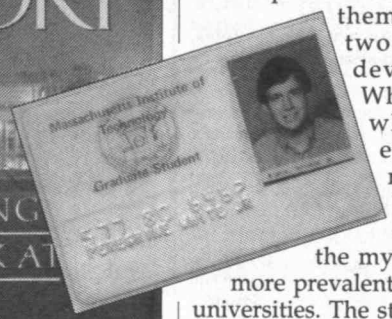
Dubious that a non-initiate could shed much light on this book for an audience consisting almost entirely of those who have their own stories to tell, their own strong opinions about the Institute, I enlisted the viewpoint of a fellow student of White's, Harry West, SM '84 (in Technology and Policy), PhD '86. West, an assistant professor of mechanical engineering at MIT and inheritor of the legendary 2.70 Design Contest, read *The Idea Factory* in one (albeit long) sitting on a flight to Japan. He found it both readable and enjoyable. While there have been numerous autobiographical accounts of undergraduates at other institutions, White's book appears to be the first of its ilk published for the general public on graduate life at MIT.



Two issues dealt with in *The Idea Factory* that are particularly prevalent at the Institute resonated with both West and a student I talked to. Most central is the problem of funding. At nearly every other university, graduate students know before they arrive whether or not they will have support. But at MIT, the scramble to nail down a research assistantship ("smile and dial") while new students are also trying to get acclimated and begin classes creates enormous pressures. "It's a beautifully pure example of the free market," says West, "because every student hustles to find the best job, and every professor hustles to find the best student." So every supplicant encounters a whole lot of "maybe's" while the shakedown is under way.

Less critical, but emotionally loaded, is the problem of eating alone at MIT. That could probably be the subject of a entire treatise. On heading to Walker on the first day of class, White comments, "It's not fun to eat by yourself, but it's tolerable if you have the notes from your classes to look over. It seemed like about half the tables were occupied by parties of one, so it didn't bother me so much to be alone." But, as West points out, MIT is a school that does not even "schedule" lunch—in fact, 12-1 is one of the key lecture hours. "In some ways I think that this is the most profound comment that he makes in the book—people at MIT often eat alone,"says West. "And I think that's a major problem. Not only is it sad, but also after graduation, eating with people, being with people, being part of the team, is a very important skill. That is how business is done."

There were also several threads in the book with which West took issue. One is the question of suicide, a recurring theme to which at least two chapters are also devoted. A friend of White's did kill herself while both were enrolled at MIT, but much of the rest of his treatment is anecdotal and buys into the myth that suicide is far more prevalent at MIT than at other universities. The statistics in fact do not support that notion—while obviously any number is too high, MIT is right in the middle of institutions with similar student populations, according to Robert Randolph, associate dean of Student Assistance Services. Both Randolph and West believe that perpetuating the myth is unfortunate.



West found a related focus of the book in a paragraph written in the anguish following Mary's suicide: "It wasn't the pressure. She was too smart to let that do it. Maybe it was the loneliness. But she had a boyfriend. Perhaps it was the hopelessness spurred on by MIT's overmechanistic world-view, in which logic and reason are gods, and spirituality, soul, and humanity are dismissed as irrelevant at best and nonexistent at worst." West disagrees with that assessment of the Institute and finds it disturbing that some MIT students experience the Institute that way.

The pressure, he acknowledges, is indeed real, as aptly described by White's friend Ari when he compares getting a degree from MIT with his experience as an Israeli soldier: "The Six Day War was hard, but at least it was only six days. Sometimes I wonder whether I'm going to make it out of [MIT] alive." But West does not believe that humanity and spirituality are dismissed as irrelevant at the Institute, nor are they sacrificed to the "gods" of logic and reason. "It is difficult to bring in ethical issues when teaching a basic course in dynamics," West admits. "But in the dormitories, fraternities, humanities [classes], and public services, students' humanistic and spiritual concerns express themselves. Humanity and spirituality are not required by the Institute, but they are certainly here—you just have to look."

White didn't pass the qualifying exams and go on to a PhD. But as his remark about learning to think shows, it was not a waste of three years. "In many ways he's an ideal student," says West, "Although it would appear that he was not the most natural mechanical engineer . . . clearly he understood what mechanical engineering is all about. Better than some students I have taught who have done much better in classes at MIT. Because they can just so naturally do the equations, they don't have to think about it at all. And unfortunately if they don't have to think about it, they're not aware of what it is they're doing. [They] think the problem *is* the mathematics. Whereas Pepper was quite aware that that's not the problem. The problem is some sort of physical problem out there, and you're modelling it into the form of some mathematics to manipulate it, and then you hope that when it is transformed back into the physical domain, you can do some good with it."

For those of White's colleagues and contemporaries who may wonder if they appear in the book: Well, the real names of key professors are used; given the powerful working styles of MIT professors, that's probably the only intellectually honest way to do this book. But all other characters are more or less composites based on Pepper's experiences. And for those who crave a few problem sets thrown in with their reading every now and then, *The Idea Factory* certainly fills the bill.—*Faith Hruby* □

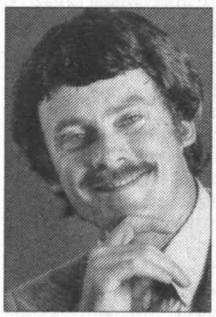
It's nice to have most of the VI-A students back from their summer work assignments and to hear of their experiences. The VI-A Program continues its fine reputation among the students!—John Tucker, Director (emeritus), VI-A Internship Program, MIT, Room 38-473, Cambridge, MA 02139-4307.

VII BIOLOGY

Lance Davidow, PhD '77, sends word: "I am now with Collaborative Diagnostic Services, Inc., in Waltham, Mass. I am manager of New Test Development, working on DNA-based clinical tests for genetic diseases and cancers."

VIII PHYSICS

Cyril M. Harris, PhD '45, the Charles Batchelor Professor Emeritus of Electrical Engineering and professor emeritus of Architecture at Columbia University, has taken office as the 85th president of the New York Academy of Sciences since its founding in 1817. . . . **Michael Riordan**, '68, PhD '73, and **David N. Schramm**, '67, have written *The Shadows of Creation: Dark Matter and the Structure of the Universe* (W.H. Freeman and Company, 1991).



M. Riordan

D.N. Schramm

Riordan is working for a year in Washington, D.C., as a staff scientist at the Universities Research Association. Schramm is the Louis Block Professor in the Physical Sciences at the University of Chicago.

Rear Admiral **John Elmer Dacey**, SM '49, of Sarasota, Fla., has died. He was buried in Arlington Cemetery on May 15, 1991 with full military honors including the 13-gun salute to a rear admiral. Although Dacey was eligible for a career as a naval constructor, he chose to remain a line officer eligible for command at sea.

X CHEMICAL ENGINEERING

Patrick Wong, SM '62, sends word from Palo Alto, Calif.: "I am executive director of Oral Products at the Alza Corp. We developed Procardia XL, a once-a-day antihypertensive and antianginal drug for Pfizer. Since the drug was introduced in 1989, it has exceeded all initial sales records of the American pharmaceutical industry. The expected sales in 1991 will exceed 700 million in the U.S. alone.". . . News has come to us via Frank Phillips, Class of '36 Secretary, of **Jim Seth**, SM '36. "Seth and his wife Nellie Katherine are much interested in archeology and history and belong to the Archeological Conservancy. They have explored the "four corners" area of New Mexico, Utah, Arizona, and Colorado by land and by river rafting. They have also seen the "mound builders" sites in Ohio, old mining towns, the Canadian Maritime Provinces, and this year, the famous petroglyphs of Bandolier, 20 miles west of Santa Fe."

Max Bender, SM '37, has written *Interfacial Phenomena in Biological Systems* (Marcel Dekker, Inc.). The book, which is part of the Surfactant Science Series, "focuses on necessarily complicated interfacial aspects of biological systems—integrating appropriate physics and chemical concepts with up-to-date biological knowledge," states a publisher's news release. . . . **Gerard C. Coletta**, SM '68, a VP with the FPE Group, a professional consulting firm specializing in risk control located in Lafayette, Calif., has been re-elected to serve on the board of trustees of the ASTM Institute for Standards Research. His three-year term begins in January 1992. A member of ASTM since 1977, Coletta is actively involved with Committee F23 on Protective Clothing, having served as chair from 1979 to 1985 and as vice-chair from 1986 to 1988. According to an ISR press release, "his responsibilities on the board of trustees include reviewing research proposals submitted to the board that could ultimately strengthen ASTM standards and benefit the standardization, industrial, commercial, and research communities as a whole."

G.C. Coletta

Robert B. Egbert, SM '40, ScD '41, of Albuquerque, N.M., died on July 10, 1991. His doctoral thesis, written in 1942, is now the basis of much of the current discussion on global warming, a subject he was working on prior to his death. He was one of four founding members of Scientific Design Co. of New York City in 1946, and later founded Chemical Process Corp. in Stamford, Conn. Several of his patented inventions contributed to important commercial developments in the petrochemical industry, among them the revolutionizing of the process for the manufacture of both dacron and mylar. In recognition of his lifelong achievements in science, Egbert was recently named a Fellow of the AAAS. After his retirement, Egbert dedicated much of his energy and resources to environmental issues. Among other involvements, he was a founding member of the 1001 Club, a nature trust instituted by the World Wildlife Fund's international conservation program.

Frank W. Smith, Jr., ScD '49, of Merrimack, N.H., died on July 30, 1991. Before his retirement, Smith was VP for research and engineering at Mine Safety Appliances in Pittsburgh, Pa., where he worked for 23 years. He was a member of the National Security Industrial Association, the Industrial Research Institution, and several other organizations. . . . **Robert C. Kennedy**, SM '32, of Niagara Falls, N.Y., died on April 23, 1991. A licensed professional engineer, Kennedy worked for Mathieson Alkali in Saltville, Va., before being transferrd to Niagara Falls in 1945 by the Olin Mathieson Corp. He retired in 1976 from Olin as assistant plant manager after 44 years of service. He was a member of the American Institute of Chemical Engineers, American Chemical Society, Air Pollution Control Association, and the Gyro Club. . . . The Alumni/ae Association has been notified of the following deaths: **Fred L. Chase**, ScD '42, of Arlington, Mass., on July 28, 1991; **Richard W. Asmus**, SM '48, of Lakewood, Ohio, on May 17, 1991; and **Yuen N. Lee**, SM '39, of San Francisco, Calif., on June 21, 1988. There was no further information provided.

XI URBAN STUDIES AND PLANNING

Frederick Merrill, Jr., SM '80, MCP '80, writes: "I

am currently a VP with the Finch Group, Inc., which is a full service real estate development and management firm in Boston. I am responsible for the firm's real estate development work, which is mostly multi-family residential and hotel work. We are also doing a lot of work with banks in New England, providing workout and development management services for distressed properties owned by the banks."... **Yok-shin F. Lee**, PhD '88, reports: "I attended an international conference in Hanoi in July and presented a paper on 'Managing the Urban Environment in Developing Countries.' I visited Ho Chi Minh city and met with Vietnamese researchers to explore opportunities for collaborative research on urban environmental management. I will be preparing a chapter on 'Urban Environment in Asia' for the United Nation's Economic and Social Commission for Asia and the Pacific (ESCAP) Report on the State of Urbanization in Asia and the Pacific. Currently I am a research associate with the East-West Center in Honolulu, Hawaii."... **Lucia' Edmonds**, PhD '79, sends word from Washington, D.C.: "I am president of a consulting firm, Lucia' Edmonds & Associates (LEA), specializing in increasing the effectiveness of managers in public, private, and non-profit organizations. My specialites include managing diversity, team building, conflict utilization, and strategic planning. I am an adjunct professor with the American University and Georgetown University teaching courses in consulting skills, intervention skills, organization development, and training theory & design."

From Littleton, Colo., **Catherine Koza**, MCP '90, writes: "I have completed my assignment with the United Nations Office of the Coordinator for Afghanistan (UNOCA) and am currently working with the United Nations in the Western Sahara, which was until 1975 a Spanish colony and since that time has been administered by the Government of Morocco. The UN is currently charged with organizing and overseeing a referendum that will determine whether the territory becomes independent or integrated into Morocco."... Sasaki Associates, Inc., of Watertown, Mass., has promoted **Jonathan Warner**, MCP '86, from planner to senior associate. The 300-person firm has offices in seven U.S. metropolitan areas.... **Vilma Barr**, '73, is director of Communications at CUH2A, Inc., in Princeton, N.J. The firm, which specializes in office buildings and facilities for R&D, has a national client base comprised primarily of Fortune 100 firms.

Edward H. Kaplan, SM '79, MCP '82, PhD '84, associate professor of policy modeling and public management and associate professor of operations research, has received his third Yale University appointment: he now holds an associate professorship in the Department of Internal Medicine at the medical school. Kaplan's affiliation with the medical school came about as a result of his work evaluating New Haven's legal needle exchange program. His evaluation design draws from his several years of research modeling the spread of HIV infection (he has published over 15 papers on this subject), and is the first of its kind in the world. His study relies on syringe tracking and testing, which in effect lets the needles do the talking. At the VII International Conference on AIDS in Florence, Italy, he presented preliminary results that revealed the program appears to be reducing the incidence of new HIV infections among injecting drug users participating in the needle exchange by 33%. Mention of his work has appeared in many publications, including the *New York Times*. In May, Kaplan received the Alumni Teaching Award from Yale School of Management students and alumni for excellence in teaching. This followed his receipt of an Elm-Ivy Award, a civic award recognizing his work evaluating the needle exchange program. Kaplan is co-departmental editor of Public Sector Applications for the journal *Management Science* and associate editor for *Operations Research* and the *Journal of Sex Research*.

Eugene Yu-Cheng Hsi, SM '54, of Baltimore, Md., died on July 28, 1991. Hsi was president of Transviron, Inc., an engineering company specializing in water and sewer projects. He was a founder of the firm, then known as Hsi, Brenner, and Day, in 1961. He also owned Sugar Plum, a candy and gift shop in the same building. A member of the board of the Chinese Language School and the council of the Hackerman House, he was also a founder of the Baltimore-Washington Chapter of Rho Psi Fraternity. He was active in the Chinese Folk Art Corp. and several restaurants. A former president and a member of the board of the Organization of Chinese Americans, Hsi was active in Baltimore's sister city program with Xiamen, China

XII EARTH, ATMOSPHERIC, AND PLANETARY SCIENCES

Peter Neilley, SM '84, PhD '90, writes: "I am a visiting scientist in the Research Applications Program at the National Center for Atmospheric Research in Boulder, Colo."

The Alumni/ae Association has been notified that **Edward Theodore Clapp**, '47, of Columbia, Md., died on March 24, 1991. There was no further information provided.

XIII OCEAN ENGINEERING

A. Paul Amesse, SM '67, NE '67, reports: "I have been elected to the board of directors of the MIT Club of Washington. I am the director of business development for the Technology, Management, and Analysis Corp. in Arlington, Va.... Captain **Dennis K. Kruse**, SM '73, SM '73 (II), USN, is the new commanding officer of the David Taylor Research Center (DTRC). Prior to joining DTRC, Kruse was commander of the Naval Ship Systems Engineering Station in Philadelphia, Pa. He gained fleet experience as damage control assistant, CIC officer and navigator on the destroyer escort USS *Courtney*, and as engineer officer on the guided missile frigate USS *Talbot*. DTRC is the Navy's principal R&D, test, and evaluation center for Navy ships, submarines, and advanced craft. Of primary concern are new vehicle concepts, ship and aircraft compatibility, ship trials, and the development of vehicle technology. Kruse oversees a research budget totalling over $400 million and a workforce of nearly 2,800 scientists, engineers, and support personnel.

D.K. Kruse

Rear Admiral **William F. Petrovic**, SM '41, of Bremertown, Wash., died on June 25, 1991. Prior to his retirement in 1972, Petrovic had spent 5 years as the Puget Sound Naval Shipyard commander, at a time when the Navy crossed the nuclear threshold. The shipyard under Petrovic developed first the capability to do overhauls, refueling, and conversions on nuclear subs and then nuclear-powered surface ships. During his tenure, the yard built the fast combat support ships USS *Seattle* and the USS *Detroit* and the destroyer tender *Puget Sound*. Petrovic held many other posts, one as a deputy director of the Department of Defense. From 1963 through 1966, he served as an assistant chief of the Bureau of Ships, inspector general, and commander of the New York Naval Shipyard until its closure. He

was the recipient of several awards including the American Defense Medal, American Campaign Medal, Asiatic-Pacific Campaign Medal with two operations stars, the World War II Victory Medal, and the Navy Occupation Service Medal.

XIV ECONOMICS

John G. Turnbull, PhD '47, sends word from St. Paul, Minn.: "Not much to report. Growing older but still healthy. Continuing with volunteer work at Nature Centers—an interest I've had since boyhood.". . . **Beverly Hirtle**, PhD '86, has been appointed a manager and assigned to the Banking Studies Department at the Federal Reserve Bank of New York in New York City. She joined the bank in 1986 as an economist in the financial markets department. Between 1986 and mid-1990 she held various positions in the research area. In mid-1990 she was reassigned to the banking studies department. Hirtle has written several articles for *Quarterly Review*. . . . Two Course XIV professors, **Rudiger W. Dornbusch**, Ford International Professor of Economics and Associate Department Head, and Professor **James M. Poterba**, are the editors of *Global Warming: Economic Policy Responses* (MIT Press, 1991). "Global warming is debated largely in environmental terms. The contributions in this book focus instead on the economic effects of global warming, providing an excellent summary of current thinking on this important issue," states the book's jacket.

XV MANAGEMENT

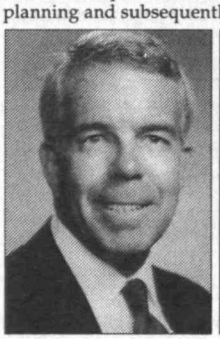
Eldon E. Senner, SM '71, writes: "I left the World Bank in 1988 (after 17 years), trading corporate life and the challenges of international economic development work for the joys and traumas of owning and operating (with my wife, Sally), one's own business—in this case, a wonderful country inn, The Cooper Beech, in Ivoryton, Conn.". . . From Marblehead, Mass., **Richard St. G. Sides**, SM '72, reports: "My daughter, Annie Kathleen, is a sophomore at the University of California at Berkeley and on the dean's honor roll for her performance studying Greek, Latin, and art. Her brother, Robert, is a junior in high school, outstanding at math and science. I am CFO at Questus Corp., a company that designs and makes surgical instruments, mostly used for arthroscopic repair of knees.". . . **Liane J. Pelletier**, SM '84, has been named a VP for market management by Sprint's Consumer Services Group in Kansas City, Mo. Pelletier will be responsible for directing CSG's customer-base management and retention. She joined Sprint in November 1986 as vertical marketing manager and held various positions in product management and development. . . . **Dodds Buchanan**, PhD '63, professor of marketing in the College of Business at the University of Colorado in Boulder, sends word: "I was recently elected chair of the audit committee of the board of directors of the 16 Fund Mutual Fund Complex of United Funds, managed by Waddell & Reed of Kansas City. I am associated year round with the University of Colorado, but teaching only each fall. I am spending more time with Buchanan Ranch Corp., in Cody, Wyo. Last (of a joint nine) offspring graduated from college in June. Whew!"

L.J. Pelletier

. . . From Newton, Mass., **Ross S. Silverstein**, SM '87, writes: "I have been married for two years to my lovely wife, Amy. I am in my fifth year as a corporate attorney with Goodwin, Procter & How, concentrating in acquisitions, financings, and franchising."

Patrick Centanni, SM '81, VP at State Street Bank in Boston, reports: "Last March, Ellen and I had our first child, a daughter, Rebecca Muriel Centanni.". . . **K. Stuart Peskin**, SM '89, is now an assistant VP at State Street Bank & Trust. He had been in the Asset Management Division of the Boston-based bank. . . . **Laurence B. Timm**, SM '83, is director of North American Sales for the Athens Corp. in Oceanside, Calif. Prior to this he was with Teradyne, Inc., in Costa Mesa, Calif. . . . **Richard Rabins**, SM '79, has been appointed to the board of directors at Legacy Technology, Inc., in Woburn, Mass. Rabins is the co-chair of Alpha Software Corp., a company specializing in relational database systems, and the co-founder and president of the Massachusetts Computer Software Council, a forum for advancing business, legal, and ethical issues in the software industry.

John P. "Jack" McNichols, Jr., SM '79, has been promoted to a newly created post as VP for total quality performance at Aeroquip Corp., a TRINOVA Company, in Maumee, Ohio. "McNichols is responsible for monitoring the progress of all Aeroquip operations worldwide toward meeting the company's commitment of providing world-class quality and customer service. He joined TRINOVA Corp. in 1981 as director of business planning and subsequently was promoted to VP before he joined Aeroquip in 1990, serving most recently as VP in the company's International Group," states a company news release. Aeroquip produces products ranging from flexible hose, fittings and assemblies to refrigeration/air conditioning components and various aerospace and automotive products. . . . **Wendell C. Brase**, '70, SM '70, has been named vice chancellor of administrative and business services at the University of California at Irvine. He joins UCI from UC/Santa Cruz, where he served in a similar capacity as vice chancellor of finance, planning, and administration. Brase is responsible for one of UCI's largest divisions, with 598 employees and an operating budget of $58 million. The Office of Administrative and Business Services oversees such departments as human resources, police, parking and transportation, facilities management, environmental health and safety, physical planning, purchasing, and accounting.



J.P. McNichols

W.C. Brase

Sloan Fellows

Sadao Takematsu, SM '78, writes: "In June, the Mitsubishi Bank suggested to me that I should accept the managing director's chair of Japan Storage Battery Co., Ltd. JSB, located in Kyoto City, is Japan's largest battery manufacturer. I'm forced to live away from my family in Tokyo. This is a typically Japanese phenomenon called 'Tanshin-Funin.'" . . . **Dorothy B. Derick**, SM '81, VP of Fleet National Bank in Providence, R.I., has been named a member of the board of directors at the Sturbridge Corp., in Sturbridge, Mass. . . . **Robert E. McKee III**, SM '83, has been named senior VP for administration at Conoco, Inc., in Houston, Tex. Previously he was the company's VP for refining and marketing in North America. . . . **Daniel R. Hesse**, SM '89, has been named president and CEO of AT&T Network Systems International, a manufacturer and marketer of network telecommunications products for Europe and selected countries around the world. It is headquartered in Hilversum, The Netherlands, and employs more than 6,000 people. Hesse joined AT&T in 1977 and has held several assignments in the company's services divisions during the past 14 years. . . . **Richard J. Santagati**, SM '79, has joined the investment firm of Cooper & Olbrych as a special partner after resigning as CEO of Gaston & Snow law firm. He joins a four-year-old investment firm specializing in private equity investments in growth-oriented companies and in management buyouts. Among other affiliations, Santagati is chair of the board of trustees of Merrimack College and a board member of the Sloan School.

D.R. Hesse

Senior Executives

John P. Desbarres, '84, has been named president, CEO, and director of Transco Energy Co., in Houston, Tex. Previously he was chair, president, and CEO of Santa Fe Pacific Pipelines, Inc., in Los Angeles.

The Alumni/ae Association has been notified that Sir **Derek G. Ryan**, '69, of Elbirlle, West Germany, died on January 3, 1990. Ryan was UK managing director of Forum Institut für Management in Heidelberg and for many years he was in charge of their English subsidiary company.

Management of Technology Program

Roger Glovsky, SM '91, has a new position with Kirkpatrick & Glovsky. He is a lawyer specializing in growth-oriented high tech companies. . . . **Hisao Inagaki**, SM '91, is with the North America Division of the North American Affairs Bureau of the Ministry of Foreign Affairs in Tokyo. He follows current situations in the U.S., studying the presidential election, congressional elections, and congressional issues. He is also involved with matters of policy in U.S.-Japan relationships as well as Canada-Japan relationships. . . . **Naoki Kato**, SM '91, was appointed senior manager for the Research Planning Department at NTT LSI Laboratories in Tokyo. In August he wrote that after two months the family was unpacked, but since they had purchased so much while in the U.S., some of the household things still can't find their way to their proper places. . . . **Hiroyuki Ogawa**, SM '91, is studying at Stanford this year. It sounds as if the summer term wasn't too bad—micro economics, Japanese economics, linear algebra, and beginner's tennis. Good luck this fall term!—Fay Wallstrom, Management of Technology Program, MIT Rm. E56-304, Cambridge, MA 02139.

XVI AERONAUTICS AND ASTRONAUTICS

From Fort Belvoir, Va., Colonel **John O. Blackwell**, SM '53, writes: "I am going to attend the 50th anniversary of my undergraduate class of

1941 at Virginia Polytechnic Institute where I got a BS in physics. I am enjoying retirement at the Fairfax Marriott Lifecare Retirement Community.". . . Brigadier General **Richard T. Drury**, SM '61 (ret.), reports: "I retired from the Air Force in 1982 and I'm now a senior lecturer and assistant chair of the Department of Aerospace Engineeering and Engineering Mechanics at the University of Texas at Austin.". . . **Donald H. Lewis**, SM '59, sends word: "I am currently spacecraft manager for the Tracking & Data Relay Satellite Continuation Program at NASA headquarters in Washington, D.C.". . .

T.A. Crites

Troy A. Crites, '79, SM '80, has received the President's Achievement Award for Analysis, one of the highest honors of the The Aerospace Corp., where Crites is employed as principal director of Strategic Defense Initiative Architecture. He received the award for "exceptional contributions to the SDI program through analysis and improvement of advanced defense architectures."

Ralph W. Rawson, SM '46, of Madeira Beach, Fla., died on August, 3, 1991. Rawson was city manager of Madeira Beach for almost 14 years until his retirement in 1986. During his career, the city remained debt free as it undertook several developments, including opening a recreational complex, building a marina, and erecting a chamber of commerce building. As a Navy captain he won the Distinguished Flying Cross in World War II for sinking a German submarine with a 600-pound depth charge dropped from a plane. In the reserve, he rose to rear admiral.

XVII POLITICAL SCIENCE

Raymond Grenier, SM '71, and George Metes have written *Enterprise Networking: Working Together Apart* (Digital Press, 1992). According to the book's inner sleeve, "This book develops strategic and practical approaches to building a capability-based environment for prospering in this complex and rapidly changing world. The focus is on simultaneous distributed work environments, in which electronic networks and networking techniques are used to access, communicate, and share the information that fuels the development of modern products and services." Grenier is a marketing executive in the telecommunications and information systems areas at Digital Equipment Corp. He has been associated with telecommuncations and networking for over 30 years. He served with the U.S. Air Force and has held management positions with General Telephone and BB&N Communications Corp.

John Dennett Urmston, SM '78, of Bolinas, Calif., died unexpectedly on August 8, 1991. After moving to California in 1979 he settled in San Francisco where he worked for 12 years at Bank of America as a VP in the Government Relations Division.

XVIII MATHEMATICS

Samuel A. Ellias, PhD '75, writes: "I was appointed assistant professor of neurology in the Clinical Neuroscience Department of Brown University on July 1990 after completing a Teacher Investigation Development Award at the Neurology Service of Massachusetts General Hospital and the Brain and Cognitive Sciences Department at MIT. I am a neurologist at Roger Williams Medical Center in Providence, R.I., where I am conducting research on movement disorders and computational neuroscience.". . . **Eric Reissner**, PhD '38, has been elected an Honorary Member of ASME. He was selected for "his profound and lasting mark on international applied mathematics through over a half century of teaching, 300 research papers, and wise counsel at the highest levels of ASME."

Edward H. Kaplan, SM '82, associate professor of policy modeling and public management and associate professor of operations research, has received his third Yale University appointment: he now holds an associate professorship in the Department of Internal Medicine at the medical school. Kaplan's affiliation with the medical school came about as a result of his work evaluating New Haven's legal needle exchange program. His evaluation design draws from his several years of research modeling the spread of HIV infection (he has published over 15 papers on this subject), and is the first of its kind in the world. His study relies on syringe tracking and testing, which in effect lets the needles do the talking. At the VII International Conference on AIDS in Florence, Italy, he presented preliminary results that revealed the program appears to be reducing the incidence of new HIV infections among injecting drug users participating in the needle exchange by 33%. Mention of his work has appeared in many publications, including the *New York Times*. In May, Kaplan received the Alumni Teaching Award from Yale School of Management students and alumni for excellence in teaching. This followed his receipt of an Elm-Ivy Award, a civic award recognizing his work evaluating the needle exchange program. Kaplan is co-departmental editor of Public Sector Applications for the journal *Management Science* and associate editor for *Operations Research* and the *Journal of Sex Research*.

XX APPLIED BIOLOGICAL SCIENCES

Nevin S. Scrimshaw, MIT Institute Professor Emeritus, has been awarded the World Food Prize for 1991 for achievement in improving the quality, quantity, or availability of food in the world. It is the first time in its five-year history that the prize, given for accomplishments in food and agriculture, is being awarded for contributions in the area of nutrition. Scrimshaw, who currently directs the Food, Nutrition, and Human Development Program for the United Nations University of Tokyo and serves as a member of Harvard University's Center for Population Studies, received the prize, including a cash award of $200,000 and a sculpture by world-renowned designer Saul Bass, last October. Scrimshaw came to MIT in 1961 as professor of human nutrition and head of a new Department of Nutrition and Food Science. In 1976 he established the International Food and Nutrition Planning Program at MIT, which provided training in nutrition research for scientists in developing countries. In 1980, as Institute Professor, he began research on the functional consequences of iron deficiency and developed methods for getting iron into the diets of people in underdeveloped countries. Today he remains one of the principal advisors to international and national organizations in the field of food and nutrition. Scrimshaw has received numerous awards, including most recently the 1990-91 Alan Shawn Feinstein Merit Award for Public Service.

XXI HUMANITIES

Richard L. Cartwright, linguistics and philosophy professor at MIT, received a graduate alumni citation from Brown University in recognition of his contributions to society through scholarship and professional activity. It said: "A 'philosopher's philosopher,' [Cartwright] has taught at MIT since 1967 and since 1985 has been head of the Department of Linguistics and Philosophy. His essays are regarded as classics, legendary for their analytic insight and craftsmanship. In 1987, MIT published a collection of his work, *Philosophical Essays*, and in 1988 honored him with a Festschrift.". . . **Alan Lightman**, Writing Program Professor of Science and Writing at MIT, has written *Ancient Light: Our Changing View of the Universe* (Harvard University Press, 1991). According to the book jacket, Lightman "tells the story of cosmology, including its history, the theories and the evidence, the new discoveries, the outstanding questions, and the controversies. Striking and original analogies enliven the book and make it accessible to the general reader."

XXII NUCLEAR ENGINEERING

Dave Frech, SM '68, writes: "I retired from Duke Power Co. in February, 1990, and am living in Charlotte, N.C., (no change). I am pursuing my hobbies of bird watching and tennis."

John William Holland, SM '59, of La Jolla, Calif., died on July 9, 1991. Holland worked for Atomics International before joining General Atomics in 1961. He was a pioneer in the field of thermionic nuclear systems and was widely known for his expertise in the engineering and management of advanced space-power systems. After his retirement in 1984, he continued to act as a consultant and visited the Soviet Union to start a dialogue on cooperation in thermionic reactor technology. . . . **Winston Henry Francis**, ScD '86, of Sao Paulo, Brazil, drowned in a swimming accident on December 31, 1989. He worked in the Department of Mechanical Engineering at Pontíficial Católica Universidade in Rio de Janeiro.

TPP TECHNOLOGY AND POLICY PROGRAM

Clint Andrews, SM '85, and Ellen Cotter were married on July 20, 1991. They moved to New Jersey where he is now a professor at The Woodrow Wilson School of Princeton University. . . . **Kevin Fitzgerald**, SM '86, is a doctoral candidate at Wharton, having left the World Bank. . . . **Alice Outwater**, SM '87, and Bob Lang have an addition to their family. Samuel Outwater Lang was born on July 9, 1991. . . . **Steve Anderson**, SM '87, visited **Isna Soedjatmoko**, SM '87, at an energy conference in Jakarta. . . . **Victor Gobbell**, SM '90, has joined the staff at Polaroid in Freeport, Mass. . . . **Hossein Mohsenzadeh**, SM '90, has been promoted to assistant VP at Bankers Trust International in London. . . . **Ann Hatcher**, SM '91, has a new position at the New England Electric Systems in the Demand Planning Department.—Réné Smith for Richard de Neufville, Technology and Policy Program, MIT, Rm. E40-252, Cambridge, MA 02139.

STS PROGRAM IN SCIENCE, TECHNOLOGY & SOCIETY

Professor **Loren Graham**, on leave in Chicago for the academic year 1991–92, returned to Boston in late September en route to Moscow where he co-hosted a conference on "Social, Cultural, and Political Dimensions of the Environmental Crisis in the U.S. and U.S.S.R." The conference was sponsored by STS and funded by the MacArthur Foundation. . . . Professor **Lily Kay** gave a talk

entitled "Life as Technology: Representing, Intervening, and Molecularizing" to the History of Science Group at the University of California at Berkeley on October 7. . . . Professor **Carl Kaysen** was one of three American participants in a seminar on "New Elites in Eastern Europe: Who Will Lead the New Market Economy?" held at Central European University Center in Prague, in August 1991. Kaysen is a coauthor with DACS Colleague George Rathjens and Robert McNamara, former U.S. Secretary of Defense, of "Nuclear Weapons After the Cold War," published in the current issue of *Foreign Affairs*. Kaysen has spent the fall term at the Institute for Scientific Interchanges in Turin, Italy. . . . Professor **Kenneth Keniston** has become a member of the NASA Workshop on Cultural Aspects of SETI (Search for Extra-Terrestrial Intelligence). The workshop explores the "effects on humanity of detection of a signal from an extraterrestrial civilization." NASA's large-scale investigation will begin on Columbus Day, 1992.

Professor **Leo Marx** presented a talk entitled "Environmental Degradation and the Ambiguous Social Role of Science and Technology" at the conference on Social, Cultural, and Political Dimensions of the Environmental Crisis in the U.S. and U.S.S.R. in Moscow. . . . Professor **Theodore Postol**, '67, SM '72, PhD '76, attended the International Summer School on Science and World Affairs in Moscow at the end of June. In August, he spoke on strategic nuclear weapons to the National Security Fellows at Harvard University. He was also a discussant at the Naval War College First Annual Force Planning Conference on "Strategy and Forces for a Changing Security Environment" in Newport, R.I. Postol's op ed piece, "Whoops! Patriot Missile Sputters" appeared in the *San Diego Tribune* on July 18. . . . Institute Professor **Walter Rosenblith** participated in a symposium in Montreal on the early history of the International Brain Research Organization (IBRO). He had been an officer of IBRO in the early 1960s, when IBRO's individual membership amounted to several hundred. Now IBRO plays the role of a world federation of nearly 30,000 neuroscientists and of the societies in which they are grouped. In June Rosenblith went to Beijing as chair of the advisory panel to the Chinese University Development Project to deliver an evaluation report to Li Tieying, head of the State Education Ministry. . . . Professor **Sherry Turkle** announced the arrival of a daughter, Rebecca Ellen Willard, in May.

Caren Addis, an STS graduate student, gave birth to a son, Gabriel, on August 15. On hand for the event was her husband and fellow student, **Antonio Botelho**. . . . **Patricia Bentley**, gave birth in May to a daughter, Kathryn. . . . **Eric Kupferberg** presented a paper, "The Bergey's Manual and the Solidification of Bacterial Taxonomy," at the International Conference for the History, Philosophy, and Social Study of Biology, July 10-14 at Northwestern University. He also attended a two-week course on "The History of Modern Evolutionary Thought" held at the Marine Biological Laboratory in Woods Hole and sponsored in part by the Dibner Institute for the History of Science. . . . **Steven Reber**, '81, is the proud father of baby Charlotte, who arrived last spring. . . . **Jessica Wang** married MIT Economics student Brian Sliker on August 23. Jessica and Brian met as office-mates in the STS students' office. . . . **Cheng-lin Zhang** has been awarded the Sir RunRun Shaw Fellowship. This two-year award is funded by the Shaw Foundation in Hong Kong, and is earmarked for support of students from the People's Republic of China who have "a bent towards science and management courses."—Phyllis Klein, STS Program, MIT, Rm. E51-128, Cambridge, MA 02139.

Deceased

The following deaths have been reported to the Alumni/ae Association since the *Review* last went to press: '

Stanford A. Guthrie, '15

John Homan, '15; August 9, 1991; Indian Rocks Beach, Fla.

John H. Holton, '17; September 1, 1991; Skaneateles, N.Y.

George F. Halfacre, '18; August 9, 1991; Palmerton, Penn.

Edward A. Merrill, '22; August 15, 1991; Tulsa, Okla.

Charles A. Nicholson, II, '22; July 21, 1991; Laguna Niguel, Calif.

Robert Prescott, '22; August 1, 1991; Wayne, N.J.

Thomas F. Richardson, '23; September 5, 1991

Robert C. Sprague, '23; September 27, 1991; Williamstown, Mass.

Edwin D. Wilson, '23; May 21, 1991; Everett, Wash.

Clarence Edwin Miller, '24; August 7, 1991; Hampton, Vir.

Paul E. Pihl, '24; July 18, 1991; Charleston, S.C.

Maurice Grushky, '25; December 24, 1988; Charleston, S.C.

John E. McMaster, '26; September 7, 1991; Wareham, Mass.

William Crighton Sessions, '26; August 29, 1991; Grosse Pointe Woods, Mich.

Jack B. Peters, '27; September 10, 1991; Lenox, Mass.

Charles St. George Pope, '27; July 7, 1991; Richmond, Vir.

George Clahane, '28; August 29, 1991; Acton, Mass.

Harry E. Shoemaker, '29; February 16, 1991; Temple City, Calif.

Philetus H. Holt, '30; August 30, 1991; Summit N.J.

Willard A. Morain, '30; July 23, 1991; Mt. Vernon, Ohio

Carlton E. Vanderwarker, '30; August 21, 1991; Boca Grande, Fla.

Clement H. Hamblet, '31; August 13, 1991; Newark, Dela.

Murray J. Lalone, '31; Closter, N.J.

Alfred Ziegler, '31; September 10, 1991; Palmer, Mass.

Gerard M. Kincade, '33; June 20, 1991; Pittsburgh, Penn.

Waldron S. MacDonald, '33; August 30, 1991; Concord, Mass.

James H. Burke, '34; September 19, 1991; St. Simons Island, Ga.

Sumner B. Sweetser, '34; August 11, 1991; Farmington, Conn.

Florence J. Driscoll, '35; S. Easton, Mass.

John W. Aldrich, '37; August 25, 1991; Woodbury, Conn.

Charles Frederick Healey, '37; August 1, 1991; Jamesburg, N.J.

Haskell R. Gordon, '38; September 17, 1991; Worcester, Mass.

George E. Shea, '38; August 26, 1991; Bedford, Mass.

Harold H. Butler, '39; May 2, 1991; Nutley, N.J.

Mortimer A. Schultz, '39; June 29, 1991; Mashpee, Mass.

Yuen N. Lee, '39; June 21, 1991; San Francisco, Calif.

Earle D. Benson, '40; August 26, 1991; Reading, Mass.

Augustus Peter Norton, '40; February 22, 1991; Stafford, Vir.

George W. Clark, '41; August 9, 1991; Topsfield, Mass.

William H. Yocom, '42; August 10, 1991; Bethlehem, Penn.

Warren A. Hurley, '47; August 15, 1990; Hendersonville, N.C.

William Atkinson Schmidt, '48; August 19, 1991; Mansfield, Mass.

John Elmer Dacey, '49; May 15, 1991; Sarasota, Fla.

Frank G. Lane, '49; September 3, 1991; Middlebury, Vt.

Kenneth R. Greider, '50; July, 1990; Davis, Calif.

Douglas H. Martin, '50; August 1, 1991; Allentown, Penn.

Dellieware R. Nelson, '51; August 25, 1991; Cambridge, Mass.

Eugene Yu-Cheng Hsi, '54; July 28, 1991; Baltimore, Md.

Bryant Gunsenhouser, '56; August 3, 1991; Anderson, Ind.

Richard Lee Unruh, '56; July 26, 1991; Long Beach, Calif.

John William Holland, '59; July 9, 1991; La Jolla, Calif.

Margaret L.A. MacVicar, '65; September 30, 1991; Cambridge, Mass.

H. Kent Bowden, '68; September 4, 1991; Houston, Tex.

Percy G. Holton, '69; May 7, 1991; Devon, England

Derek G. Ryan, '69; January 3, 1990; Elbirlle, West Germany

Robert B. Foster, '77; September 12, 1991; Chicago, Ill.

John Dennett Urmston, '78; August 8, 1991; Bolinas, Calif.

Winston Henry Francis, '86; December 31, 1989; Sao Paulo, Brazil

Thomas Rolf Petersen, '90; August 1, 1991; Munich, Germany

ALUMNEWS

Continued from page MIT 7

the black astronaut who lost his life in the *Challenger* explosion.

•Stanley Rose, an MIT telethon volunteer in New York City for more than 15 years, has been remarkably effective in enlisting project support from his employer, Bankers Trust, notably in providing a site and catering the callers' dinner.

Presidential Citations honor unusual service to the Institute and the Alumni/ae body by its member organizations. This has been a blockbuster year, with citations going to six alumni/ae groups:

•The Class of 1950 Student Aid Fund, established at the class's 25th Reunion, now totals more than $2 million and is MIT's largest class-supported financial aid fund. The fund has helped hundreds of students and their families by providing scholarships and subsidizing loan interest.

•The MIT Club of Cape Cod, founded in 1976, has demonstrated the best that clubs can offer their members, through an annual directory, quarterly newsletter, broad range of speakers, and notable efforts to reach out to all members of the MIT community in the region.

•In the three short years that it has been in operation, the Young Alumni Steering Committee of Boston has done an exemplary job of organizing events tailored to the interests of graduates from the past 10 years.

•Since Greg Turner '74 led a revival of the MIT Club of South Texas seven years ago, the club has grown steadily and has established a positive MIT presence in Houston.

•The MIT Club of Boston was honored for its black-tie gala at the Boston Museum of Fine Arts to welcome President Charles Vest and Becky Vest. The event attracted 450 guests.

•The Productivity Commission "Road Show," a collaboration of the Alumni/ae Association staff, MIT clubs in eight cities, and the MIT Industrial Liaison Program, was honored for its success in bringing the *Made in America* report of the MIT Commission on Industrial Productivity to more than 1,600 attendees coast to coast. The Road Show attracted national media attention and demonstrated MIT's concern for the national agenda to a wide audience.—*Judith Norkin.* □

PUZZLE CORNER

Continued from Page MIT 55

languages. Eugene Sard has a 9x9 solution but needed an unabridged dictionary for three words. The following 9x9 from the proposer used only *Webster's Students Dictionary* and *Random House College Dictionary.*

A	Q	U	A	■	A	J	A	R
R	U	N	T	■	W	A	D	E
K	I	D	■	S	E	I	Z	E
S	T	O	M	P	■	L	E	D
■	■	■	Y	E	A	■	■	■
F	O	B	■	E	X	C	E	L
A	V	O	I	D	■	O	D	E
R	E	N	T	■	H	A	G	S
E	N	D	S	■	A	L	E	S

A/S 3. Our last regular problem is from Nob. Yoshigahara. Choose two digits excluding 0 and 1 and consider the set of numbers that contain each of the two digits at least once. For example, 4 and 8 gives 8848, 4884, 84 and infinitely many others. Now consider the smallest member of this set that is a multiple of the two original digits. Call this the LYM (least Yoshigahara multiple). In our example the LYM is 48; the LYM of 3 and 5 is 3555. Among the 28 pairs of digits, 4 lead to sets that do not contain a multiple of the digits and, for these pairs, the LYM is not defined. For example, all multiples of 2 and 5 end is 0 so are not in the set constructed from 2 and 5. The LYM of 2 and 4 is 24, which is the smallest of the LYMs. What is the largest?

Apparently considerable searching, guided by some heuristics such as "casting out nines," was needed for this problem. Farrel Powsner found this question to be a good exercise for teaching problem solving to high school students. Powsner's results were as follows.

23 - 2232	46 - 4464
24 - 24 (smallest)	47 - 44744
25 - none	48 - 48
26 - 2226	49 - 4,444,444,944
27 - 2772	56 - none
28 - 2888	57 - 5775
29 - 2,222,222,292	58 - none
34 - 3444	59 - 5,555,555,595
35 - 3555	67 - 76776
36 - 36	68 - 6888
37 - 37737	69 - 6696
38 - 3888	78 - 7,888,888
39 - 3339	79 - 77,777,779,779 (largest)
45 - none	89 - 8,888,889,888

Other Responders

Responses have also been received from R. Bart, D. Boynton, S. Bragg, B. Bramley, D. Church N. Cooke J. Cronin, C. Dale, L. Daley, J. Drumheller, S. Feldman, M. Fountain, J. Grossman, J. Harmse, W. Hartford, R. High, K. Kiesel, D. McMahon, A. Ornstein, D. Plass F. Powsner, G. Ropes, K. Rosato, J. Rudy, D. Savage, A. Tracht, and H. Zaremba,

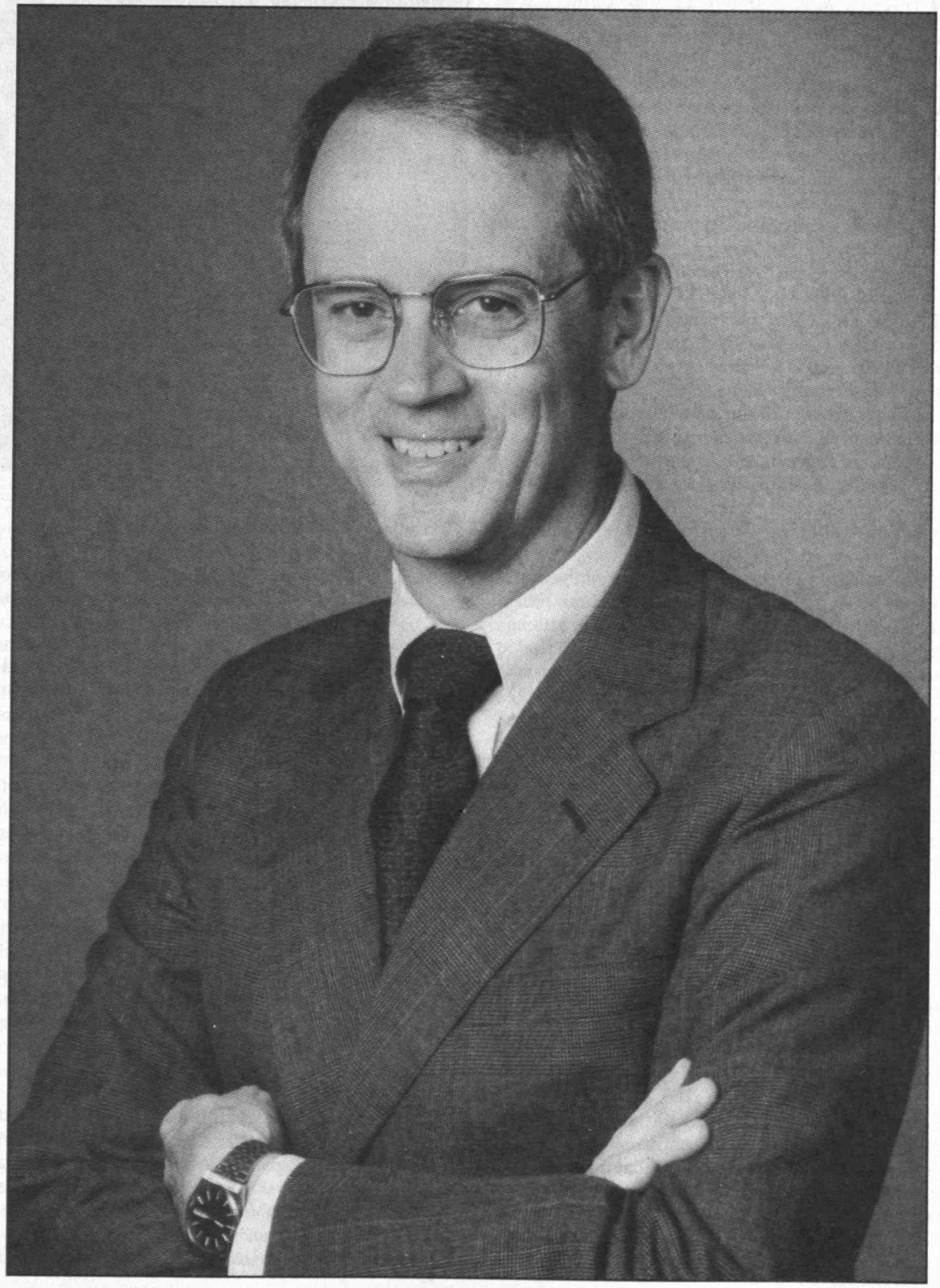
Proposer's Solution to Speed Problem

One can have a never-ending tie, constant scoring (without making 3 outs), an infinite series of foul balls, an infinite series of unsuccessful pickoff attempts, or an eternal rundown.

Massachusetts Institute of Technology

REPORT OF THE PRESIDENT

For the Academic Year 1990-91



OBSERVATIONS ON THE FIRST YEAR

My first year as president has been marked particularly by the need for MIT to respond to a host of challenging external forces. At a time when I wanted primarily to concentrate on setting a long-range agenda for the future of the Institute and on involving the community in strategic planning, MIT has faced a flood of external actions and issues that have demanded unremitting attention. Some of these issues — such as the matter of intellectual integrity in the conduct of research — touch all universities. Other external actions are more narrowly focussed on a few universities — such as the Justice Department allegations regarding "price-fixing" on financial aid.

Many of these outside forces are troubling, some could be seriously damaging. But while I regret the sheer time and effort that dealing day-to-day with these matters has required, the fact is that they are by no means unrelated to the long-range planning on which we need to concentrate. Indeed, they have served as a lens to bring into focus many of the issues that we must address in defining and shaping our future. They speak to us of a changing nation and world. And many represent an erosion of the partnership between the federal government and our research universities.

Changing Public Attitudes

Yet the matter is deeper than the erosion of the sense of partnership between the government and the universities. In our democratic system, the actions of the Congress and the executive branch ultimately reflect the views and will of the people. Thus, we must look more closely at public perceptions and attitudes toward our research universities. MIT historically established the paradigm for these universities and retains its preeminence today; hence these are critical matters for us.

I surmise that the origins of changing public attitudes toward our research universities are twofold:

- First, there is a growing wave of populism and an associated widespread distrust of expertise, excellence, and privilege, whether real or perceived.
- Second, there have been direct assaults, largely on ideological grounds, against our universities. These began in earnest when William Bennett used his pulpit as Secretary of Education to attack American higher education. The flames he ignited were fanned by others, including the picture of the presumed decline of higher education painted by Allan Bloom in *The Closing of the American Mind*, and the intemperate portrait of the American professoriat by Charles Sykes in *Profscam*.

Criticisms of universities have struck a resonance with the public, which had taken account of rapidly rising tuitions and come to believe, almost antithetically, that the quality of teaching and the commitment to undergraduate education, had degenerated. It is a resonance that we must worry about. It calls for serious self-examination.

PHOTO: BARRY HETHERINGTON

Catalytic Federal Actions

Against this backdrop this past year came three catalytic federal actions — the investigations at Stanford of alleged abuses of the system for reimbursement of indirect costs of sponsored research; the further investigation of the matters surrounding fraud charges associated with the *Cell* paper by Weaver, Baltimore, and others; and the continuing investigation by the Justice Department of alleged conspiracy and price-fixing among universities.

While these activities captured the headlines, still other actions were proceeding with less public attention. They included the decline of peer review of academic research and facilities proposals and the corresponding increase in political earmarking; investigations about conflicts of interest on the part of faculty with strong ties to industry; debates about technology transfer from U.S. universities to foreign countries, particularly Japan; criticisms about the numbers of foreign students studying engineering and science in American universities; and a continuing decline in the effective level of federal financial support of students.

Diagnosis and Prognosis

What does all of this mean? To what extent are these forces aimed at MIT specifically? What is the prognosis? What can we do? There are no definitive answers to these questions, but I would like to share some thoughts about them.

First, what does it mean? It means, basically, that our universities are not immune to the strains present in our

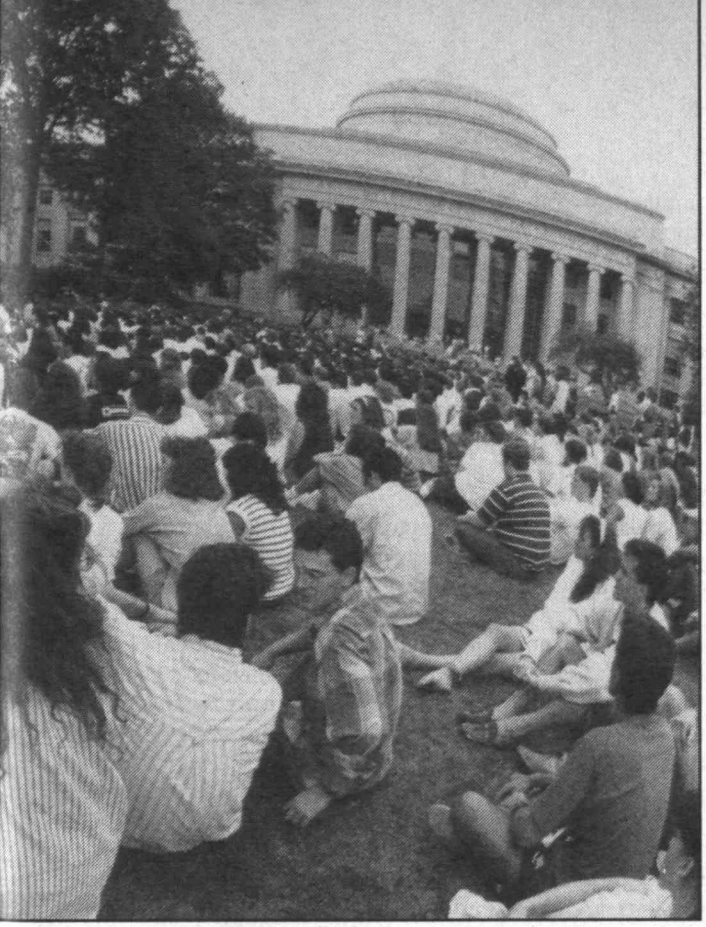


PHOTO:PAULA LERNER

society, and that tight budgetary times and shifting, or indeed uncertain, federal priorities are likely to have profound implications for us. It means further that we must strive energetically to understand the forces at work, and their causes, and then develop ways of dealing with them. Thoughtless defensiveness is neither an appropriate nor helpful response. We must listen to and talk with our critics as well as serve as critics. We must correct those areas in need of correction. We must adjust to new realities, recognizing the opportunities and responsibilities as well as the difficulties we face.

When I arrived in Cambridge last fall, MIT had been buffeted by several adverse interactions with various agencies of the federal government in rapid succession. Many believed that there was a strong anti-MIT attitude in the government, but I have not found it so. For over twelve months now, I have made monthly trips to Washington, each with a saturated schedule of visits to senators, representatives, agency heads, and other policy makers. I come away with the impression that MIT is still highly respected and viewed as an important national resource. However, I do not believe that we are viewed as being as far apart from the crowd as we have been in the past. There are also small pockets of resentment of our quality and a belief that, while many other institutions need help, MIT can take care of itself. And there is, most regrettably, a serious lack of recognition of what is required to maintain the wide range of excellence at an institution like MIT and of how very different that is from what is required to build one or two spires of excellence at other kinds of institutions.

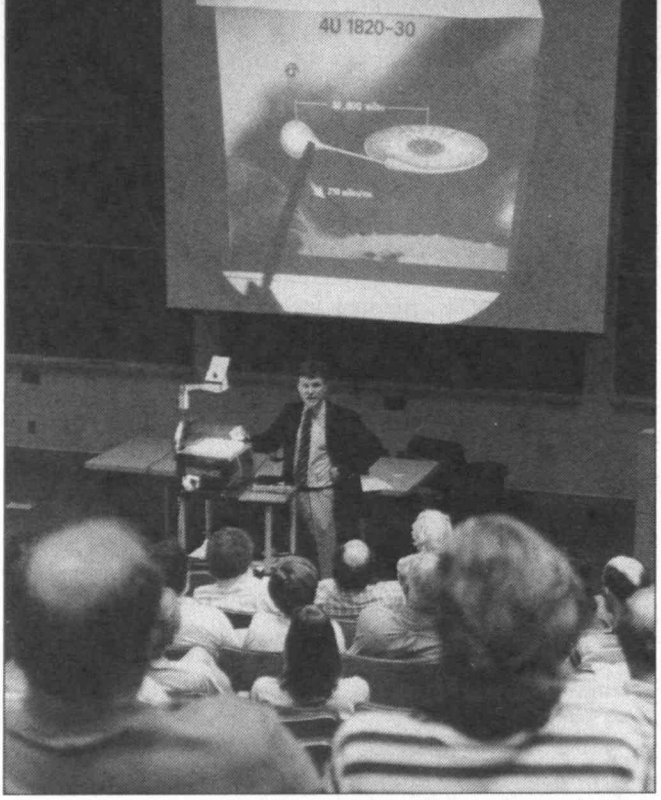
What is the prognosis? These are treacherous times. We need to take a leadership role in restoring public confidence in our research universities and in engendering a better understanding of their past contributions and of their importance to a vibrant future. These tasks should follow from our own self-assessment and dedication to leadership in a changing world. Above all, the United States must re-establish a strong and fundamental belief in education and in the importance of scientific and technological research. In his recent book *The Next Century*, David Halberstam speaks of the Japanese educational system. Regardless of one's views of the nature of that system, he states, the Japanese believe that if the young people are educated well, all else can be achieved. It is this attitude — that the development of our human capital, of people and their ideas, is prerequisite to all else that we want to accomplish — that we must regain in the United States. If we succeed in doing so, a bright future for the country, and an exciting mission for MIT, will be assured.

Changing Federal Relations

Let me now turn to some of the specific elements in the nature of MIT's relationship to the federal government that require careful analysis and action. We begin that task from a history and background of strength. Previous MIT administrations have been very well represented in the highest councils of the executive branch. Moreover, MIT faculty remain very well connected to the agencies of the federal government. They are sought out for service on key planning panels and understand the missions of the agencies very well. nontheless, I believe that the Institute today needs new responses to the apparent growing shift of responsibility for science and education policy into the more chaotic domain of the Congress. In addition to devoting a major portion of my own time to federal issues, I concluded early on that it would be wise to have a continuous presence in Washington. Accordingly, we have opened an MIT Washington Office, directed by Dr. John C. Crowley, former vice president of the American Association of Universities. This office will enable us to observe and interact more continuously with federal policy initiatives, and the related authorization and appropriations processes that affect us and our colleagues. We intend to work largely through coalition building and close collaboration with our sister institutions. The Washington Office will also serve as a gateway to MIT, assisting in bringing MIT faculty expertise to both principals and staff members in the Congress and in the executive branch. Good scientific and technological advice is needed as never before in the government, and our faculty can contribute much.

Indirect Costs of University Research

The subject of indirect costs of university research, long considered something of an arcane topic, became headline news in 1991 as a result of allegations of erroneous and inappropriate charges to the federal government by Stanford University. The subsequent government investigations riveted both Congressional and public attention on indirect costs of research, and on the



accounting/auditing procedures used to reimburse universities for those costs. These investigations, and the manner in which they were conducted and reported by the press, have tended to erode public confidence in our universities and have unleashed forces in Congress and elsewhere that have the potential to do great damage to the nation's system of higher education and research.

These investigations have also raised authentic issues, however, and the response of the university community must be to correct any legitimate problems. In particular, further tightening, clarification, and greater standardization of accounting procedures are needed to prevent erroneous charges to indirect cost pools. What is not needed is a rush to judgment that will produce an ill-considered quick fix that will harm the long-term health of our universities and our national system of research. I am particularly concerned that the responsibility for indirect cost matters should remain centered in the executive Office of Management and Budget (OMB). The specter of the details of indirect cost accounting becoming part of the annual appropriations process in the Congress is daunting

A particularly troubling aspect of the present indirect cost debate is the lack of recognition of, or commitment to, the concept that federal research support to universities serves the dual purpose of accomplishing research and educating graduate students, who comprise the next generations of researchers. In some of the debate, funding of university research has been viewed as a simple government procurement — an approach that draws no distinction between supporting university research, with its intimate involvement of graduate students, and purchasing goods and services from an ordinary supplier. This approach also appears to be promoted by some funding agencies which support policies that effectively encourage the employment of postdoctoral researchers rather than graduate students. In an era when projections show looming shortfalls in the numbers of PhD scientists and engineers in the U.S., such an approach is unwise, and we have worked hard to counter it wherever we have found it.

Relatedly, we are concerned about recommendations by some to disallow the payment of graduate research assistants' tuitions as employee benefits. The disallowance of this practice would drive an immediate two-thirds increase at MIT in the annual cost of supporting a graduate student research assistant on an individual faculty grant or research contract. A lack of supportiveness of the graduate student component of research is also displayed in various proposals for handling the partial support of library costs and the recommendation by some in Congress that the student services component of indirect costs be eliminated.

Fundamental to the process of restoring confidence in this system of cost accounting is the tenet that policies and practices should be based on principles. Therefore, I believe it is particularly important now, while we are reviewing these accounting guidelines, that we not lose sight of the fundamental principles of OMB Circular A-21, which has governed for many years the financial relationships between government and universities receiving federal funds in research. In brief, these principles are that university faculty, graduate students and staff will perform research at low cost, and that simultaneously they will maintain and advance the scientific, technological and intellectual infrastructure of America by educating the next generation of researchers. In return, the U.S. government will recognize the diversity among American universities and the dual role of graduate students in research and education, and will bear its full and fair share of costs. These philosophical and economic principles have proved extraordinarily sound and have helped make this country's university research system the world leader. Any restructuring of Circular A-21 must be solidly based on considered analysis, careful redefinition, and the preservation of the principles that have served so well.

Academic Integrity

Universities exist to pass on knowledge to succeeding generations and to generate new knowledge, analyses, and insights. We, in addition, have an overarching responsibility — to imbue in our students and ourselves a dedication to intellectual honesty as well as an understanding of the methodologies of objective analysis and the respect for reasoned discourse that lead to the establishment of scientific and scholarly truth.

Recently, a few highly publicized cases of alleged scientific misconduct have captured the public's attention. While the press and others seek to sensationalize these events, we must do more than attempt to persuade the public that if such misconduct has occurred it is a rare event — as in fact it is. In every case of alleged misconduct, we must look to the substance behind allegations, and we must continually review and refresh our commitment to basic academic values.

What are these values? What is the foundation of scientific and scholarly research that we hold fundamental? The foundation is truth, and certain intimately related concomitant

PHOTO: CHRISTOPHER MOORE

values, which Jacob Bronowski identified so well in his book of essays, A Sense of the Future. As discussed by Bronowski, these include, importantly, independence and originality; a belief in the value of dissent; and an adherence to freedom of thought and speech. Central to these values is the importance of respecting another's point of view. Points of view and hypotheses are there to be debated, tested, proved, disproved, revised, built upon, or rejected. This is what makes science — indeed most scholarship — both an individual and a highly communal activity. And it is why we say science is a self-correcting enterprise that strongly counters any forces that might tempt one to cut corners or act with less than full honesty.

Nonetheless, there are forces that push the modern university researcher in other directions. Among them are the following:

- First, the rapid expansion and communication of knowledge. Nearly instantaneous promulgation of research results by various modern means contributes to a sometimes frenetic pace that can run counter to the careful review and reworking of research that might reduce ultimate error.
- Second, the *nature of incremental advances in some fields*. In some fields undergoing rapid development, it is often the case that relatively modest advances may have great, albeit fleeting, significance. This, too, can produce a rush to disperse results that can reduce care, review, and reflection, thereby increasing the probability of error.
- Third, *the culture of instantaneous news and fame*. Scientists and scholars do have egos. They are often highly competitive, a characteristic that generally works to the advantage of science. However, when this trait is combined with the American public's unquenchable thirst for sensation and for daily dosages of revolutionary advances, extraneous temptations and inappropriate forces are created.
- Finally, the opportunity for *monetary gain*. Universities have become great engines of the modern economy, and we have increasingly worked together with profit-based industries in arrangements which have contributed significantly to the common good. Yet some of these ties between university scientists and the corporate world, with their enhanced opportunities for personal financial gain, may not always be free from the possibility of troubling conflict of interest.

The basic challenge before us is to do a better job of passing on and strengthening our system of values. How can this be accomplished? The easy suggestion is to establish formal courses and perhaps require them of all students. But this is not necessarily practical or effective. We can, also, as I have asked MIT to do, establish broader mentoring of new colleagues — faculty and students — and create occasional forums designed to help develop an environment in which the importance of intellectual integrity and scholarly values are widely understood and prized. Ultimately, however, it is in our individual and institutional actions that our values are manifested.

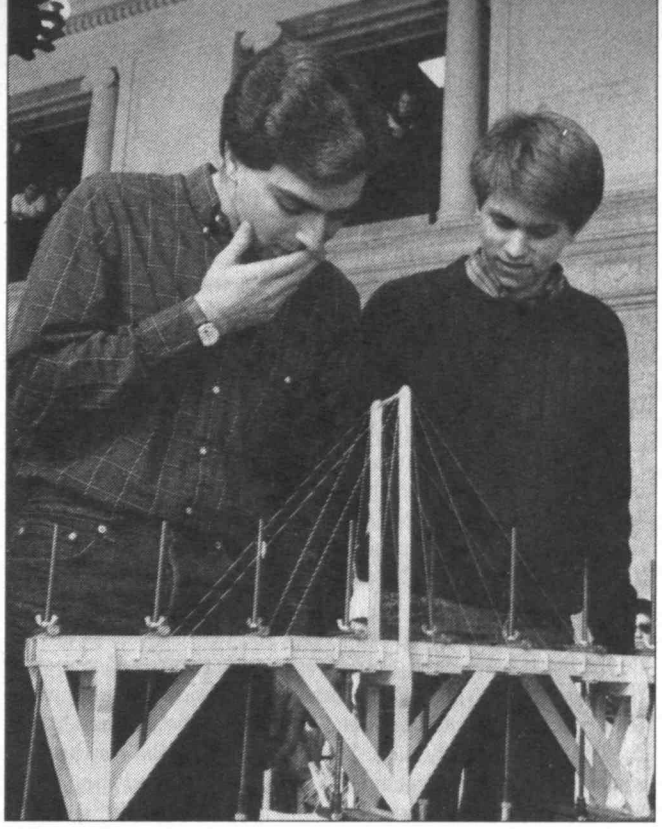


PHOTO: PAULA LERNER

Whatever we say, we teach by example. And the lesson will be conveyed best, therefore, by the ways in which we undertake our own scholarly activities and by the ways in which we deal with problems if they do arise.

We have heard great outcries, for and against, the policing of science. Our response, as an academic community, must not be one of knee-jerk defensiveness, but rather one of developing an effective method of self-governance regarding integrity in research. If we are not able to do so, we can be sure that others will be only too glad to do it for us. And what we don't need is more bureaucracy and increased overhead expenses for programs to enforce scientific integrity. To strengthen our self-governance at MIT, the Provost and I asked a group of distinguished faculty, chaired by Professor Sheila E. Widnall, to review our responsibilities and articulate our values in the conduct of academic research; to look at our own policies and procedures in light of those values; to compare these policies and procedures with federal and professional standards and guidelines governing research, and to suggest revisions where appropriate; and, finally, to propose creative ways of introducing mentoring and educational programs regarding both the conduct of research and the provision of broad career guidance throughout the entire academic community. This committee has produced an interim report which will provide the framework for Institute-wide discussion during the fall and lead to a set of specific recommendations thereafter.

Student Financial Aid and the Justice Department

A rather strange episode in our relations with the federal government continues to play itself out in a suit against MIT by the Department of Justice. Since 1989, a number of universities and colleges have been

the subjects of an investigation by the Department of Justice seeking evidence that they have conspired and violated the Sherman Antitrust Act. Hoards of government attorneys have, at great expense to the American taxpayer and to those who pay tuition and make charitable donations to these schools, combed through the records of this "industry" to spot evidence of "collusion" in restraint of trade that would suppress free market forces acting upon faculty salaries, tuition charges or financial aid to students. In May, the U.S. Attorney General brought a formal complaint against the eight Ivy League universities and MIT for colluding in the Overlap Group — meetings held by those institutions to assure that their student financial aid to applicants in common be awarded only on the basis of financial need.

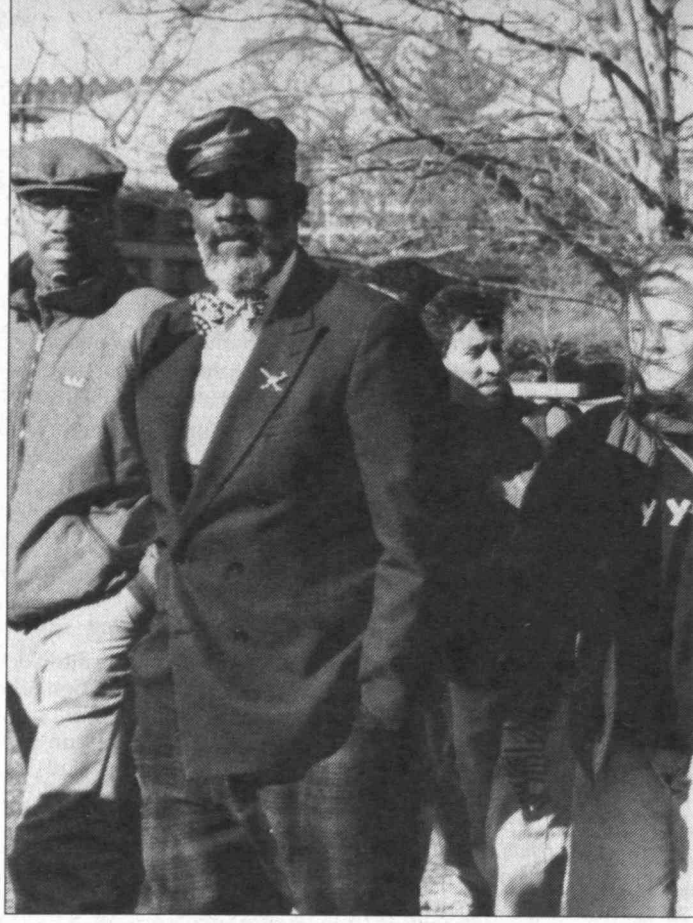
The eight Ivy League universities settled the complaint out of court by agreeing not to engage in this practice for the next ten years. MIT, after careful deliberation, decided not to sign this consent decree and therefore is being sued by the Department of Justice. We took this position for three reasons. We do not believe that we have violated the Sherman Act; we believe that there are distinguishing differences between us and the other eight universities in this matter; and we believe that our approach to need-based financial aid, and the manner in which its implementation was assisted by the Overlap Group, serves an important social function and is the best use of the limited financial aid funds available to us. We do not believe it is in the nation's interest for universities to compete financially for students.

The Department of Justice, apparently believes that financial aid would be better based on merit. They conclude that if the highly competitive schools named in their action had not jointly agreed to provide aid based on need, that some students would have received greater financial assistance, and therefore a lower effective price for their educations, and that this would be appropriate. MIT, on the other hand, has long believed that, while students should be admitted to the Institute on the basis of intellectual merit, they should be awarded financial aid based solely on their, and their families, ability to pay. Ironically, and remarkably, this long-standing MIT student aid policy is exactly the approach that was later mandated by the Congress for the use of federal financial aid funds to undergraduates.

MIT has and will defend its beliefs in this suit in a considered manner, seeking thoughtful and expert advice, and remaining cognizant of all the costs and ramifications of its actions.

The Changing Face of America : Implications for MIT

Besides these federal actions, there are a number of other external issues that impinge strongly upon us. Foremost among them, and one of deep concern is the issue of race in America. Universities are both susceptible to aspects of this issue and, in my view, responsible for working vigorously toward the solution of certain components of it. Moreover, regardless of differing views regarding the social responsibilities of higher



education, the fact remains that the racial and ethnic structure of the American populace and workforce is changing rapidly in well known and absolutely predictable ways. Students who are to be optimally educated for the world they will enter must learn from the experience of living and learning with, and from, students and faculty representing the diversity of people who now comprise the country. Furthermore, as we look at the various projected shortfalls of engineers, scientists and PhD level scholars in numerous fields, it becomes apparent that attracting and educating people from segments of our population who have traditionally not been well represented in academe is in the national interest.

MIT has played a leadership role by significantly increasing the numbers of underrepresented minority students in our undergraduate programs. Underrepresented minority students make up 16 percent of the class of 1995. Enrollments in our graduate programs, and representation on our faculty, of underrepresented minority scholars, however, have not kept pace. It is imperative that we improve this situation appreciably. At the faculty level, the Provost has recently announced a reinvigorated, funded program designed to assist departments financially in increasing the number of underrepresented minorities on the MIT faculty. We also are accelerating the conduct of programs aimed at making the opportunities for graduate study at MIT clearly known to underrepresented minority undergraduate students around the country.

MIT has also played a leadership role in the education of women in engineering and the sciences. Women comprise 35 percent of the new entering class. Substantial progress

has been made during the last two decades also in attracting women to our graduate programs and to our faculty, but more remains to be done. Here, too, the Provost will provide certain assistance for hiring women, especially at tenured levels in departments where they constitute less than a quarter of the faculty.

But attracting a more diverse faculty and student body to MIT is only part of the challenge before us. The entire environment for living and working in our universities needs concerted attention as the society of which we are a part changes. Single parents, dual-career couples, and an aging population have become the norm. Although the university cannot be expected to solve all of the problems that accrue from these changes, they require that we give proper attention to the development of a campus that is open, rewarding, and satisfying. Accordingly, following the recommendation of a recent faculty and staff committee, a Council on Family and Work will be appointed to advise and assist the administration in establishing at MIT the most satisfying environment possible.

MIT: A National and an International University

Yet another set of challenges has to do with the increasing interdependence of peoples and enterprises throughout the world. Our world is interconnected as never before — through our physical environment, through communications networks, through our production and economic systems, through politics and through expanding common knowledge bases. Similarly, our research universities have become increasingly international, an inevitable change that has led some legislators and others to question the nature of the international connections of research universities in general, and of MIT in particular.

The basic questions are obvious. Is it appropriate that so many international students are studying science, engineering and business in American universities? Nationally, for example, approximately 50 percent of the graduate students in engineering and physical science are foreign citizens, while at MIT one-third of our graduate students come from other countries. Is it appropriate for universities to receive support in the form of donations, or research funding, from foreign countries and companies? And the most difficult, and emotionally charged, question — given that our universities receive so much federal research support — do foreign companies "skim the cream" by carrying off critical technological knowledge, commercializing it, and then outcompeting U.S. firms?

During much of this past year an Institute-wide committee chaired by Professor Eugene B. Skolnikoff considered these and other issues involving our international connections, and proposed a number of policies for MIT. We have disseminated this report widely around to colleagues in government and industry, and it has received, generally, very favorable comment.

The basic principle set forth in the report is that MIT is first and foremost an American institution. We have, and will, serve the United States well. We best serve our nation, however, by being a preeminent institution of higher education and research emphasizing science and engineering. We can maintain this preeminence only if we maintain strong intellectual, professional, and personal ties throughout the world.

Science has always prided itself in its internationalism — judging people and ideas on their merit alone. This principle served us well earlier in this century when large numbers of American scholars studied in Europe, bringing back leading-edge knowledge and establishing fine academic departments and laboratories here. American universities also value greatly the numerous faculty who have emigrated to this country and have become great academic and scientific leaders. I believe that we are now entering an era when the flow of scholars and knowledge across many national boundaries will be the prerequisite for first-rate science and technology, and for first-rate universities. We must act accordingly.

The issue is admittedly complicated to an extent because of the diminished distinctions between basic and applied research in many fields, the shortened times from laboratory to commercialization, and the more intimate relationship between universities and industry. However, I believe that it would be a serious strategic error for the country to attempt to establish impermeable boundaries around our universities. Rather, we must work to gain more assurance that communications with visitors to our laboratories are two-way, that knowledge and expertise flow in as well as out.

Having said this, I believe that the fraction of international students in U.S. graduate science and engineering programs is too high. It should be a goal of our

PHOTO:FRANK REVI

secondary and undergraduate schools to educate and inspire U.S. students to move into such demanding and important programs of study rather than standing aside while more intellectually energetic and disciplined students from other nations take up the challenges. Furthermore, we must educate our U.S. citizen students appropriately and encourage them to gain experience overseas, that is, we must prepare them for leadership in the kind of world in which they will live and work.

MIT's Japan Program, to cite an instance, is an outstanding example of leadership in this area.

Education at MIT

All aspects of undergraduate education continue to be very actively discussed at the Institute, as they are in public forums, where university faculty are frequently criticized for allegedly caring more about graduate education and research than undergraduate teaching.

While American students themselves appear to be satisfied in many dimensions, they seem also to have the sense that somehow things should be better still. Undergraduates often believe that they have too many teaching assistants as instructors, not enough direct faculty contact, and insufficient academic and career counselling. And such criticism is aimed most often at research universities, the thesis being that undergraduate teaching is not valued there and that faculty often neglect their teaching responsibilities because of the emphasis on research.

With this criticism in mind, I recently asked one of our graduating seniors how he had found the quality of teaching at MIT. He answered that it was excellent in the lower level subjects, but spread over a wide range in the more advanced subjects. Expanding on this, he explained that the faculty expended enormous effort and creativity in doing a truly first-rate job in the large freshman and sophomore introductory classes, but that a student was expected to learn more independently — more like a junior colleague, if you will — in many of the more advanced subjects. This senior's response demonstrates yet another aspect of MIT's uniqueness. At most research universities the usual complaint is that the faculty seem uninterested in the large introductory courses, and only as one progresses into the advanced classes does their interest become more deeply engaged.

What then is the situation regarding undergraduate teaching at our research universities, and at MIT in particular? In contrast to what some educators are arguing today, I believe that the American research university has created a matrix within which the best possible education for the twenty-first century can take place. Its novel blending of undergraduate education, graduate education and research is what truly makes these universities the best in the world. At MIT, moreover, there is a permeating belief that our undergraduate curriculum and education constitute our institutional core and are the key to our national and world leadership. Still, vigilance is required to maintain teaching excellence and to renew and revitalize the curriculum. I believe that our record in this respect is exemplary.

In a major curriculum development this past year, the faculty voted to establish a subject in modern biology as a new General Institute Requirement for undergraduates, effective with the class entering in 1993. We believe that we are the first university to recognize, by requiring it of all students, the growing general importance of modern biology and the uniqueness of its methodologies. This will enhance still further the quality and relevance of an MIT education.

I am pleased to report also something of a quiet revolution in student counseling and personal contact between students and faculty. As we enter 1991-92, so many faculty have decided to offer freshman advisor seminars that over two-thirds of our new students are having the experience, at the very beginning of their MIT education, of meeting weekly in small groups with Institute faculty for study, discourse, and counselling.

To encourage further attention to teaching, we have just established a program of Faculty Fellows. These endowed awards will recognize faculty for outstanding contributions to our undergraduate educational programs. They are intended to have associated with them a level of prestige equivalent to endowed professorships, and will provide a discretionary scholar's allowance for a period of ten years. The Provost will solicit nominations from the community and will appoint approximately six Fellows per year. Thus, over a decade, on the order of sixty outstanding teachers will be acknowledged in this manner.

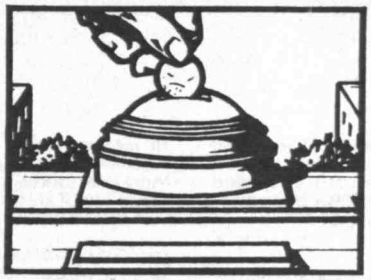
A Personal Note

In my first presidential report I have concentrated on a few trends and problem areas that are of particular significance nationally and at MIT in 1991. There is so much more that could have usefully and pleasurably been addressed. Since accepting the privilege of serving this great institution, I have found MIT to be intellectually vibrant, replete with creativity and entrepreneurship, well managed, and a great asset to this nation and world.

On a personal note, Becky and I wish to express our deep appreciation for the manner in which we have been accepted and welcomed by the MIT community. To have that friendship, warmth and collegiality coexist so wonderfully with the excellence and professionalism of our faculty, staff and students has made our transition to our new home and institution fully as much a pleasure as it has been an honor.

MIT's commitment to education, its uniqueness in mission and education, and its effective service beyond the confines of its campus have served the nation and world well for many decades. Our central challenge is clear: to continue and enhance MIT's excellence through these uncertain and changing times and into the next century. For my own part, I accept that challenge fully and enthusiastically.

CHARLES M. VEST
October 1991



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Mr. and Mrs. James Maguire
Mr. John B. McCrery *
Mr. Richard Muther
Mr. and Mrs. Philip E. Sellers
Mr. and Mrs. William S. Shamban *
Mr. and Mrs. David R. Wadleigh
Mr. Nicholas H. Wheless, Jr.
Mr. and Mrs. Albert O. Wilson, Jr.
Mr. and Mrs. David A. Wright *
Mr. St. Clair P. Yates *
Mr. Richard B. Young

1939
Mr. William S. Brewster
Mr. William King Cutten
Mr. Richard J. Donohoe
Mrs. James H. Ferry, Jr.
Mr. Frederick B. Grant
Mr. and Mrs. Michael V. Herasimchuk
Mr. Harold Hindman
Mr. James H. Laubach, Jr.
Mr. Richard S. Leghorn
Mr. Leonard Mautner *
Mr. and Mrs. Walter M. May
Mr. and Mrs. Charles S. Mercer
Mr. and Mrs. Manning C. Morrill
Mr. and Mrs. Harold J. Muckley *
Dr. and Mrs. Morris E. Nicholson
Mr. and Mrs. Gordon A. Pope
Mr. and Mrs. Harold W. Pope
Mr. Elihu Root III
Mr. and Mrs. Frederick F. Schaller

SUSTAINING FELLOWS

Mr. and Mrs. Harold R. Seykota *
Mr. and Mrs. Sidney Silber
Mr. and Mrs. Holden W. Withington

1940
Mr. Lee Hurley Bloom
Mr. Paul V. Bollerman
Mr. Walter and Mrs. Beth L. Brewer, Jr.
Mr. Thomas F. Creamer *
Mr. and Mrs. John L. Danforth
Mr. and Mrs. W. Kenneth Davis *
Mr. Robert K. Deutsch
Mr. and Mrs. Richard P. Dickson
Mr. N. Bruce Duffett
Mr. W. H. Krome George
Professor Samuel A. Goldblith *
Mr. and Mrs. Amos E. Joel, Jr.
Mr. Norman and Mrs. Alice Klivans *
Mr. H. Tyler Marcy
Mr. and Mrs. David T. Morgenthaler
Mr. I. M. Pei *
Mr. and Mrs. Franklin E. Penn
Dr. and Mrs. Karl Pfister III *
Mr. and Mrs. Edwin H. Seim *
Mr. and Mrs. R. Dixon Speas
Mr. E. M. Wallace *
Mrs. H. Garrett Wright
Mr. Alfred C. Wu

1941
Dr. and Mrs. Malcolm J. Abzug
Mr. Herman A. Affel, Jr.
Dr. and Mrs. Robert M. Fano
Dr. Daniel F. Flowers *
Mr. Raymond C. Foster, Jr.
Mr. Joseph G. Gavin, Jr. *
Mr. Lester W. Gott *
Dr. David Josefowitz
Mr. and Mrs. C. A. Kalman
Mr. Walter P. and Mrs. Carolyn Keith, Jr.
Mr. and Mrs. Edward R. Marden
Mrs. E. Kirkbride Miller *
Mr. and Mrs. Carl M. Mueller *
Dr. and Mrs. Joseph H. Myers
Dr. and Mrs. David S. Saxon
Mr. D. Reid Weedon, Jr. *
Mr. and Mrs. Frank S. Wyle *

1942
Mr. and Mrs. David M. Baltimore *
Mr. Donald C. Berkey
Mr. and Mrs. Albert F. Clear, Jr. *
Mr. Jerome T. Coe *
Mr. Frederick M. Dierks *
Mr. and Mrs. Morton E. Goulder *
Mr. Robert B. Greenes
Mr. Robert T. Howard
Mr. and Mrs. Robert R. Imsande
Mr. and Mrs. William R. Johnson
Mr. and Mrs. Maurice N. Katz
Mr. James K. Littwitz *
Mr. Floyd A. Lyon *
Mr. Lee and Mrs. Geraldine Martin
Mr. and Mrs. F. Richard Meyer III *
Mr. Jonathan H. Noyes *
Mr. Edward L. Pepper
Mr. Charles H. Smith, Jr.
Mr. James A. Stern
Mr. William C. Tallman
Mr. and Mrs. Warren W. Twaddle
Mr. and Mrs. Edward O. Vetter *
Mr. Leopold S. Wyler

1943
Mr. Earl L. Bimson *
Mr. and Mrs. Leo J. Feuer
Mr. Raymond Frankel
Mr. Arthur Graham
Mr. and Mrs. J. Robert Gunther *
Mr. Steven Heller
Mr. Rudolph Hurwich *
Mr. and Mrs. Cyrus H. Kano
Mr. and Mrs. Christian J. Matthew
Mr. and Mrs. Walter A. Netsch, Jr. *
Mr. and Mrs. Stanley M. Proctor *
Mr. John T. Shutack
Mr. S. James Spitz, Jr. *

1944
Mr. and Mrs. Burton A. Bromfield
Mr. Edgar P. Eaton, Jr.
Mr. and Mrs. John B. Gardner
Mr. Albert P. Hildebrandt
Mr. John A. Lednicky *
Mr. Robert E. Meyerhoff *
Mr. James S. Mulholland, Jr.
Mr. Bernard and Mrs. Ann Rabinowitz
Mr. Peter M. Rinaldo
Mr. Edwin G. Roos
Mr. Thornton Stearns *
Mr. Caleb S. Taft
Mr. and Mrs. Paul K. Tchang
Mr. and Mrs. Edward B. Walker III
Mr. and Mrs. Stanley W. Warshaw
Mr. and Mrs. Richard E. Whiffen
Mr. Eric M. Wunsch *

1945
Mr. George M. Berman
Mr. William F. Blitzer
Mr. and Mrs. Christopher G. Boland III
Mr. David R. Clare
Mr. and Mrs. John J. Freiberger
Mr. and Mrs. Charles H. Hart III
Mr. James A. Levitan *
Mr. and Mrs. J. Spencer Standish
Mr. Jeptha H. III and Mrs. Emily V. Wade *

1946
Mr. and Mrs. David G. Black, Jr.
Mr. Ernest U. Buckman
Mr. and Mrs. Donald E. Burke *
Mr. and Mrs. Glen V. Dorflinger
Mr. and Mrs. Charles J. Fisher
Mr. and Mrs. S. James Goldstein *
Mr. Kermit Greene
Mr. and Mrs. Alan R. Gruber
Mr. and Mrs. Herbert J. Hansell
Mr. and Mrs. Theodore W. Henning
Mr. and Mrs. Theodore P. Heuchling
Mr. Sheridan C. F. Ing
Mr. Angus N. MacDonald *
Mr. William H. Schield, Jr.
Mr. Roger and Mrs. Joan Sonnabend *
Mr. Marshall P. Tulin
Mr. James L. and Mrs. Faith P. Waters *

1947
Dr. and Mrs. Harl P. Aldrich, Jr. *
Dr. and Mrs. Jordan J. Baruch
Mr. and Mrs. John M. Bradley
Mr. Claude W. Brenner
Mr. Harold Brown
Mr. and Mrs. Paul M. Cook *
Mr. and Mrs. Quentin D. Groves
Mr. Philip R. Jonsson *
Mr. John Karmazin, Jr.
Dr. and Mrs. Henry Lee, Jr.
Mr. Robert E. McBride
Mr. and Mrs. William J. McCurdy
Mr. and Mrs. W. Robert Melville
Mr. and Mrs. Bernard G. Palitz *
Mr. Willis B. Reals
Mr. Jack W. Rizika
Mrs. Robert L. Solnick
Mr. Donald M. Van Greenby
Dr. Mary F. P. Wagley *

1948
Mr. and Mrs. Harold L. Abroms
Mr. Lester R. Ackerman *
Mr. and Mrs. Donald J. Atwood
Mr. and Mrs. Vaughn L. Beals
Mr. and Mrs. Jack A. Belz
Mr. Kenneth S. Brock
Dr. and Mrs. Robert W. Deutsch
Mr. and Mrs. Ralph L. Evans, Jr.
Mr. Daniel J. Fink
Mr. and Mrs. Thomas W. Folger
Mr. Robert P. Frenzel
Mr. Max E. Gellert *
Mr. and Mrs. Bernard H. Geyer, Jr.
Mr. Bernard M. Gordon *
Mr. John H. Grover
Mr. Russell A. Gwillim
Mr. E. W. Hiam *
Dr. Alan F. Kay *
Mr. George M. Keller *
Mr. Warren J. King *
Mr. Philip and Mrs. Lois Macht *
Mr. and Mrs. George Macomber
Mr. and Mrs. William B. Maley
Mr. Solomon Manber
Mr. and Mrs. William R. McEwen, Jr.
Mr. Denman K. McNear *
Mr. Peter M. Saint Germain *
Mr. and Mrs. Philip W. Skove
Mr. Peter H. Spitz
Mr. and Mrs. A. Graham Sterling
Mr. C. Vincent Vappi *
Mr. and Mrs. Albert Weis
Mr. and Mrs. William J. Weisz *
Mr. William R. Zimmerman *

1949
Mr. and Mrs. James K. Berman
Mr. E. Milton and Mrs. Paula L. Bevington
Mr. and Mrs. Leonard Bezark, Jr. *
Mr. and Mrs. Bruce L. Calhoun
Mr. and Mrs. George F. Clements, Jr.
Mr. Russell N. Cox
Mr. Alexander V. and Mrs. Brit J. d'Arbeloff
Dr. and Mrs. Ira Dyer
Mr. Bradford M. Endicott *
Mr. and Mrs. Donald L. Gillespie
Dr. George N. Hatsopoulos *
Dr. and Mrs. John P. Horton
Mr. and Mrs. William C. Howlett
Mr. Karl F. Kirchner
Mr. and Mrs. Michael M. Koerner
Mr. John and Mrs. Geraldine Kunstadter *
Professor A. Scheffer Lang
Mr. and Mrs. James Maslon
Mr. Harold A. B. McInnes
Mr. John O. Merrill, Jr.
Mr. S. Leslie Misrock
Mr. and Mrs. William P. Reynolds, Sr.
Mr. and Mrs. Jack C. Tang *

1950
Mr. and Mrs. Jack A. Arnow
Mr. Ronald E. Brandon
Mr. and Mrs. Herbert L. Hochberg
Mr. and Mrs. John C. Kern
Mr. Edwin C. Kruse
Dr. and Mrs. Francis F. Lee
Mr. and Mrs. Robert W. Mann *
Mr. Kenneth H. Olsen *
Mr. Lindsay Russell
Mr. and Mrs. Harry Tecklenburg *
Dr. William D. Walther *

1951
Dr. W. Gerald Austen
Mr. Nick F. Badami
Mr. and Dr. David A. Bossen
Mrs. Joan Goody
Dr. Marvin Grossman *
Mr. and Mrs. Frank E. Heart
Mr. Thomas P. Kelly
Mr. Breene M. Kerr *
Dr. and Mrs. Anthony D. Kurtz *
Mr. and Mrs. William L. Maini
Mr. Walter A. Rajki *
Mr. Paul G. Smith
Mr. Charles H. Spaulding
Mr. and Mrs. James C. Staples
Mr. and Mrs. Albert L. Zesiger
Mr. Harry J. Zimmer

1952
Mr. Joseph F. Alibrandi
Dr. and Mrs. Yaichi Ayukawa *
Mr. Alexander L. M. Dingee, Jr.
Mr. and Mrs. Herbert H. Dow *
Mr. Irwin J. Grossman *
Mr. Ernest A. Grunsfeld III *
Mr. J. Burgess Jamieson
Mr. Edward C. Levy, Jr.
Mr. and Mrs. Joe F. Moore
Mr. Swraj Paul
Mr. and Mrs. James R. Reese

1953
Mr. Gunther W. Balz *
Mr. and Mrs. Frederick R. Cronin

Mr. Jesse D. Erickson
Mr. and Mrs. Nicholas W. Fast
Mr. Robert J. Gellert
Mr. and Mrs. James D. Kolb
Mr. Thomas J. Perkins
Mr. and Mrs. Richard P. Simmons
Mr. Howard S. Stern
Dr. Martin Wohl *

1954
Mr. and Mrs. James J. Baker *
Mr. Robert H. Brown, Jr.
Mr. Alexander W. Dreyfoos, Jr. *
Mr. Donald T. Goldberg
Dr. Paul E. and Mrs. Priscilla K. Gray *
Mr. and Mrs. Andrew S. Kariotis
Mr. Ronald A. Kurtz *
Mr. and Mrs. John E. Preschlack
Mr. and Mrs. Joseph B. Scheller
Mr. George and Mrs. Catherine Schwenk
Mr. and Mrs. Harvey Steinberg
Mr. and Mrs. William S. Zoino

1955
Mr. Gerald Cohen
Mr. George P. Edmonds, Jr. *
Dr. and Mrs. Charles C. Ladd
Dr. and Mrs. Russell G. Meyerand, Jr.
Mr. and Mrs. Jean Montagu *
Mr. DuWayne J. Peterson, Jr.
Mr. George B. Raymond
Mr. L. Dennis Shapiro *
Mr. and Mrs. Victor M. Tyler

1956
Mr. C. Gordon Bell
Mr. Roger and Mrs. Brenda Borovoy
Mr. Gideon I. Gartner
Mrs. Joseph Gaziano
Mr. John L. Kelly
Mr. Matthew Lorber
Mrs. Claire and Dr. Philip M. Platzman
Mrs. Thelma K. Pollard
Mr. and Mrs. Michael Schiller
Dr. Stuart Z. Uram
Dr. and Mrs. Andrew J. Viterbi
Mr. and Mrs. Harris Weinstein

1957
Mr. Harry B. Duane *
Mr. Charles G. Koch *
Mr. Alan M. May
Mr. and Mrs. Fred L. Morefield
Dr. and Mrs. Leslie M. Orloff
Dr. John Psarouthakis
Mr. Ray and Mrs. Marie Stata
Mr. Elliot K. Wolk

1958
Mr. and Mrs. Joseph J. Gal
Dr. Robert W. Hausslein
Mr. Stanley and Mrs. Bonnie Klein
Dr. and Mrs. Emanuel E. Landsman
Mr. Sanford M. Nobel
Mr. Cornelius Peterson
Mr. Carlos Prieto
Mr. and Mrs. James Simons
Mr. and Mrs. Glenn P. Strehle
Dr. F. Helmut Weymar and Mrs. Caroline Weymar*

1959
Mr. and Mrs. R. Michael Hendricks
Mr. Albert P. Hinckley, Jr.
Mr. Patrick J. McGovern, Jr.
Mr. David J. McGrath, Jr. *
Mr. Robert A. Muh *
Dr. and Mrs. John William Poduska, Sr.
Dr. William D. Putt
Mr. Barry and Mrs. Lynn Weinberg

1960
Dr. Barry R. Bronfin
Mr. and Mrs. Thomas H. Farquhar
Mr. Jerome and Ms. Marlene K. Goldstein
Mr. Fred Kayne *
Mr. William C. Morris
Mr. John W. Norris, Jr.
Dr. and Mrs. James K. Roberge
Dr. and Mrs. Jorge E. Rodriguez
Dr. David H. Staelin

1961
Mr. and Mrs. Wesley W. Allen
Dr. and Mrs. Jerome H. Grossman
Mr. Ira J. Jaffe
Mr. David N. Ness
Mr. and Mrs. John S. Reed *
Mr. Richard B. Slifka
Mr. Clement Vaturi
Mr. Bennett and Mrs. Ellen Zarren

1962
Mr. Robert H. Heinmiller, Ms. Susan K. Kubany
Mr. Gerald L. Katell
Mr. David H. Koch *
Dr. William I. Koch *
Mr. Alan and Mrs. Judith Kotok
Mr. Edward H. Linde
Mr. John A. Rollwagen
Mr. Martin N. Rosen
Mr. Arthur J. Samberg
Mr. R. E. Wilhelm
Mr. G. Mead Wyman

1963
Dr. Raymond and Mrs. Constance Carroll
Mr. John K. Castle *
Mr. and Mrs. James A. Champy
Mr. Lawrence C. Erdmann
Dr. and Mrs. Thomas P. Gerrity, Jr.
Mr. and Mrs. J. Michael Greata
Mr. L. Robert Johnson
Drs. Joseph and Judy Nemec
Mr. and Mrs. James W. Poitras
Dr. Kenan E. Sahin
Mr. and Mrs. Grant M. Wilson

1964
Mr. and Mrs. Robert L. Blumberg
Dr. and Mrs. Gerald J. Burnett
Mr. Richard A. Carpenter
Dr. Charles C. Counselman, III
Mr. and Mrs. Joseph L. Kirk
Mr. Alton B. Otis, Jr.
Mr. A. Neil Pappalardo
Dr. and Mrs. Andrew Silver
Mr. and Mrs. Robert E. Thurber

1965
Mr. and Mrs. James J. Bochnowski
Dr. and Mrs. William R. Brody
Mr. Karl Chang
Dr. Peter A. and Mrs. Susan H. Klock
Dr. and Mrs. Hajime Mitarai
Mrs. Takeshi Mitarai
Mr. and Mrs. William H. Pike
Mr. Wayne Thurman

1966
Mr. Paul Rudovsky *

1967
Dr. Reinier Beeuwkes, III
Mr. Kevin J. Kinsella
Dr. William G. and Mrs. Diane F. Thilly
Mr. Charles Ying *

1968
Dr. Richard A. Blanchard
Dr. and Mrs. Steven Finn
Mr. Richard I. and Dr. Karla H. Karash
Dr. Robert M. and Mrs. Robyn S. Metcalfe
Mr. Kenneth P. Morse
Mr. Richard Ying *

1969
Mr. James H. Black, Jr., Mrs. Marilyn S. Black PhD
Mr. Denis A. Bovin
Mr. Peter Nicholas Goulandris
Dr. and Mrs. Samuel H. Maslak
Mr. and Mrs. Edward A. Seykota
Mr. and Mrs. Robert A. Swanson

1970
Mr. Charles L. Housman *

1971
Mr. and Mrs. Fred A. Middleton
Mr. and Mrs. H. DuBose Montgomery

1972
Dr. Douglas T. Breeden
Mr. and Mrs. Terrence A. Tobias *

1973
Dr. Martin G. and Mrs. Eleanor A. Walker

1976
Mr. Neil E. Rasmussen

1977
Mr. Brian Hughes and Ms. Lissa Martinez

1978
Ms. Katherine T. McLeod

Aeronautics & Astronautics
Dr. and Mrs. Yao T. Li *
Mr. and Mrs. John A. Long
Dr. and Mrs. Robert C. Seamans, Jr. *

Architecture
Mr. Armand P. Bartos *

Biology
Dr. and Mrs. David Baltimore
Dr. Thomas H. and Dr. Janis Fraser
Dr. Barry J. Fry

Chemical Engineering
Dr. Samuel W. Bodman III
Mr. and Mrs. Vernon O. Bowles *
Mr. and Mrs. David Brown *
Dr. John R. Brown, Jr.
Dr. and Mrs. Joseph Byrne *
Mr. and Mrs. Jerry A. Cogan, Jr.
Dr. Robert S. Davis
Mrs. Edwin R. Gilliland *
Mr. Robert C. Gunness *
Mr. John C. Haas *
Mr. C. J. Harrington *
Mr. George S. Harrington
Mr. and Mrs. Charles B. Henderson
Mrs. Frederic Holloway
Mr. Mark Hyman, Jr.
Mr. Earp F. Jennings, Jr.
Dr. and Mrs. Ralph Landau *
Dr. John P. Longwell
Mr. Jan W. Mares *
Mr. and Mrs. Jerry McAfee
Mr. C. B. McCoy *
Mr. Robert L. Mitchell *
Mr. Ralph D. Patch *
Dr. Charles E. Reed *
Mr. O. Charles Roddey
Mr. and Mrs. William C. Rousseau
Dr. Keith E. Rumbel
Dr. Arch C. Scurlock *
Dr. Charles A. Stokes
Mr. Chih Tsang
Mrs. George R. Vila *

Chemistry
Mrs. Robert G. Breckenridge *
Dr. Edward R. Kane *
Dr. Howard S. Turner *

Civil Engineering
Mr. and Mrs. Charles W. Johnson
Mr. James G. McCurdy *

Earth, Atmospheric & Planetary Sciences (includes Meteorology)
Dr. and Mrs. Louis Berger *
Dr. and Mrs. Norman E. Gaut *

Economics
Dr. Richard J. Kruizenga
Dr. and Mrs. Thomas M. Marill
Mr. and Mrs. George P. Shultz
Mr. and Mrs. Erwin P. Staller

Electrical Engineering & Computer Science
Dr. Louis B. D. Braida
Dr. Ge Yao Chu
Mr. Edward E. David, Jr.
Mr. and Mrs. Abraham I. Dranetz *
Mr. William R. Hewlett *
Mr. Stephen J. Jatras
Dr. and Mrs. William S. Jewell
Dr. David I. Kosowsky *
Mr. William E. Leonhard
Dr. Henry S. Magnuski
Mr. and Mrs. Douglas T. Ross *
Mr. and Mrs. Ben V. Thompson

Mrs. Barton L. Weller

Graduate Management
Mr. Robert W. Adenbaum
Mr. and Mrs. Carroll J. Brown
Dr. Grenville Craig
Mr. John H. Erdman, Jr.
Dr. and Mrs. Jonathan J. Golovin
Mrs. R. Joyce Harman
Mr. Mitchell Kapor
Mr. and Mrs. John Norris Maguire
Mr. Fred and Mrs. D'Maris Mangelsdorf
Mr. and Mrs. Martin Y. Tang *
Mr. and Mrs. Martin Trust
Professor James M. Utterback
Mrs. Zenon S. Zannetos

Materials Science & Engineering
Dr. David and Mrs. Sandra Bakalar *
Mr. and Mrs. J. Howard Beck
Dr. Nicholas J. Grant
Dr. Gerald G. Hatch
Dr. and Mrs. C. Sheldon Roberts
Dr. Roberto Rocca
Dr. Vasilios S. Salapatas
Dr. and Mrs. Maurice E. Shank
Dr. and Mrs. Phillip Hartley Smith *

Mr. and Mrs. John A. Stern

Mathematics
Dr. Jack Kotik

Mechanical Engineering
Mr. J. P. Barger
Mr. D. Fort Flowers, Jr.
Dr. Gail E. McCarthy
Dr. Roger L. McCarthy
Dr. and Mrs. Ting-Lin Shang
Mr. Philippe and Mrs. Katherine Villers *

Nuclear Engineering
Dr. Leonard S. Cohen
Dr. and Mrs. William T. McCormick, Jr.

Ocean Engineering (includes Naval Construction)
Mr. V. K. Atkins

Physics
Dr. and Mrs. Colgate W. Darden III *
Dr. and Mrs. H. Richard Johnson
Dr. Kenneth G. McKay
Dr. Otto Morningstar *

Senior Executive Program
Dr. and Mrs. Cuthbert C. Hurd *

Sloan Fellows Program
Mr. Oliver C. Boileau
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Mr. Colby H. Chandler
Mr. and Mrs. Marshall Wren Gabel *
Mrs. Wayne J. Holman, Jr. *
Mr. and Mrs. Barry Rosenberg
Mr. and Mrs. Goff Smith
Mr. and Mrs. Charles E. Wampler
Mr. Willis S. White
Mr. and Mrs. T. A. Wilson *
Mr. and Mrs. Yoshio Yashiro
Mr. W. Maurice Young *

Urban Studies & Planning
Mr. Theodore S. Bacon, Jr.
Dr. William W. Harris
Dr. and Mrs. Alan M. Voorhees *
Dr. Mark J. Waltch

Honorary
Mr. and Mrs. Howard W. Johnson *
Mrs. Eugene M. McDermott *
Mrs. Conchita Z. Lobdell Pearson *
Professor and Mrs. Walter Rosenblith
Mrs. Walter J. Smith *
Dr. and Mrs. Jerome B. Wiesner *

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Count and Countess Franco Antamoro '90

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1920
Mrs. Harry J. Kahn

1921
Mrs. Elliott T. Adams

1927
Lieutenant Colonel and Mrs. Jerome Lyon Spurr

1928
Mrs. Carney Goldberg

1934
Mr. and Mrs. Walter W. Bird

1936
Mr. and Mrs. Julian Rifkin

1937
Mr. and Mrs. Robert P. Rudy

1938
Mr. and Mrs. Walter F. Kaufman
Mr. Frederick E. Ray

1939
Mr. and Mrs. B. Leonard Krause
Mr. Lawrence Perkins
Mr. Theodore Wroblewski

1940
Mr. and Mrs. Winfield H. James
Mr. Frank H. Libman
Mr. and Mrs. William R. Stern

1941
Mr. Robert Wallace Blake
Mr. Martin L. Ernst
Mr. Lewis T. Jester, Jr.
Colonel William G. Kussmaul, USA (Ret.)
Mr. Newell H. McCuen
Mr. John F. Sexton
Mr. and Mrs. Robert E. Smith

1942
Mr. Ralph W. Garrett

1943
Mr. and Mrs. Robert L. Rorschach
Mr. Edmund R. Swanberg

1944
Mr. James M. Gassaway II
Mr. and Mrs. Pete E. Marenholtz
Mr. and Mrs. Joseph Shrier
Mr. John Toland

1946
Mr. L. Bates Lea

1948
Mr. John W. Herbert
Mr. and Mrs. Frank A. Jones
Mr. Sonny and Mrs. Gloria Monosson
Mr. Alvin J. Siteman

1949
Mrs. Marvin Asnes
Mr. and Mrs. Frank T. Hulswit
Mr. George Piness
Dr. and Mrs. Richard Pitler
Dr. and Mrs. Harold E. Rorschach, Jr.
Mr. Henry S. Rowen
Mr. and Mrs. Joseph Schneider
Mr. Joseph Yamron

1950
Dr. Dean S. Edmonds, Jr.
Mr. Raymond A. Kretschmer
Mr. Richard G. Rorschach

1951
Mr. George N. Butzow
Dr. and Mrs. Frederick Ezekiel
Mr. Richard L. Foster
Mr. Martin C. Murphy
Mr. and Mrs. Samuel Rubinovitz

1952
Mr. Collin W. Scarborough III

1953
Dr. and Mrs. Kent F. Hansen
Mr. Wilson H. Rownd

1954
Mr. William H. McTigue

1955
Mr. and Mrs. Paul F. Mosher
Mr. Ralph L. Wanger, Jr.

1956
Mr. and Mrs. Jacob D. Gubbay
Mr. Richard A. Jacobs
Dr. Haim Kennet
Mr. and Mrs. Philip Spertus

1957
Mr. Edgar H. Bristol II
Mr. Boyd E. Givan
Mr. Peter Samton

1958
Dr. Paul L. Busch

1959
Mr. Robert E. Brooker, Jr.
Mr. Terry L. Gildea
Mr. and Mrs. Walter J. Humann
Mr. David Polak
Mr. Robert A. Schumacker
Mr. James M. Snodgrass
Mr. Martin E. Zimmerman

1960
Mr. and Mrs. Terry F. Bower
Mr. Ulf B. Heide
Mr. Calvin S. Koonce
Mr. and Mrs. Thomas H. O'Connor Jr.
Ms. Susan E. Schur
Mr. H. J. von der Goltz

1961
Mr. Leo J. Cannon
Mr. and Mrs. Leonard I. Hess
Mr. Leslie C. Patron
Mr. and Mrs. Richard J. Resch
Mr. William P. Strauss
Mr. and Mrs. Ronald J. Yoo

1962
Dr. and Mrs. Elwyn Berlekamp

1963
Mr. Thomas R. Bogan
Mr. Mark Grebler
Mr. and Mrs. Stephen P. Kaufman

1964
Dr. and Mrs. Ronald H. Cordover
Mr. Jon D. Gruber
Dr. and Mrs. Fred Luconi
Mr. and Mrs. Robert D. Sanders
Mr. Steven M. Schlosser and Ms. Lois N. Holla
Dr. William R. Young

1965
Dr. and Mrs. George W. McKinney III
Mr. Gregory L. Schaffer
Mr. and Mrs. James W. Taylor

1966
Mr. Logan L. Donnel
Dr. John P. Hoche
Mr. Thomas O. Jones
Mr. William J. Kosinar
Mr. and Mrs. James A. Lash
Mr. Stephen Shapiro

1967
Mr. and Mrs. Thomas R. Newkirk

1968
Mr. William A. Charles
Dr. Claude Gerstle

1969
Mr. and Mrs. Larry Birenbaum

1970
Mr. and Mrs. Gregory K. Arenson
Mr. John and Mrs. Elaine Friel
Mr. David W. McComb
Mr. Walter C. Price, Jr.
Mr. Robert F. Rorschach

1971
Mr. and Mrs. James Y. Chao
Mr. Robert N. Schulte
Mr. Laurence Storch

1972
Mr. Kenneth Wang

1975
Mr. Bruce Boehm and Ms. Nancy Luberoff
Mr. Stephen and Mrs. Suzanne Chapman
Mr. John Ehara
Mr. Warren B. Lane
Mr. and Mrs. Eric Rosenfeld

1976
Mr. and Mrs. Jeffrey Halis
Mr. Robert J. Lepkowski and Ms. Jan L. Davis

1977
Dr. Thomas A. J. Frank
Mr. and Mrs. Hamid R. Moghadam
Mr. Michael W. Sonnenfeldt

1979
Mr. Bruce J. Wrobel

1980
Mr. Lawrence E. Hilibrand

Aeronautics & Astronautics
Dr. and Mrs. Robert G. Stern

Architecture
Mr. Bill and Mrs. Jean Booziotis
Mr. John I. Schlossman

Chemical Engineering
Mr. and Mrs. Jerry A. Cogan
Mrs. Robert B. Egbert
Mr. and Mrs. Andrew Sung-on Ng
Dr. A. F. Stancell

Civil Engineering
Dr. Ernst Basler *
Mr. Cordell W. Hull

Economics
Mr. Vincent A. Fulmer
Mr. Scott E. Pardee

Electrical Engineering & Computer Science
Mr. Paul J. Fox
Mr. Nolan T. Jones

Graduate Management
Mr. Luis Alvarez-Renta
Ms. Judy C. Lewent

Mechanical Engineering
Mr. William Hauser

Ocean Engineering (includes Naval Construction)
Mr. Guy and Mrs. Francoise Viellet

Physics
Colonel Frederick S. Holmes, Jr. USA (Ret.)

Political Science
Mr. Thomas W. and Mrs. Frances D. Wolf

Sloan Fellows Program
Mr. and Mrs. Robert H. Campbell
Mr. Frank Perna, Jr.
Mr. and Mrs. Alan Tawil-Kummerman
Mr. Thomas J. Vincent

Non-Alumni/ae Parents
Mr. and Mrs. William T. Kerr '92
Dr. Robert and Mrs. Judy Soley '92

Major League Eternity

This being the first issue of a calendar year, we again offer a "yearly problem" in which you are to express small integers in terms of the digits of the new year (1, 9, 9, and 2) and the arithmetic operators. The problem is formally stated in the "Problems" section, and the solution to the 1991 yearly problem is in the "Solutions" section.

Problems

Y1992. Form as many as possible of the integers from 1 to 100 using the digits 1, 9, 9, and 2 exactly once each and the operators +, -, x (multiplication), / (division), and exponentiation. We desire solutions containing the minimum number of operators; and, among solutions having a given number of operators, those using the digits in the order 1, 9, 9, and 2 are preferred. Parenthesis may be used for grouping; they do not count as operators. A leading minus sign *does* count as an operator.

JAN 1. Our "first" problem is a computer offering from Bob High. Write the first n numbers in alphabetical (dictionary) orders *as they are spelled out* (i.e., one, two, three,...one million,...). To avoid ambiguity, use no "ands" or hyphens, so 837,301 would be written "eight hundred thirty seven thousand three hundred one". 1,897 is "one thousand eight hundred ninety seven," not "eighteen hundred ninety seven." Define two functions, $F(m,n)$ and $G(m,n)$ as follows: $F(m,n)$ is m th number in the alphabetical list of the first n numbers; $G(m,n)$ is the position of the number m in this list. (For given n, F and G are inverses.) we ask:

(1) What is $F(1{,}000, 1{,}000{,}000)$? What is $G(1{,}000, 1{,}000{,}000)$?

(2) What is $F(1{,}000{,}000, 1{,}000{,}000)$? What is $G(1{,}000{,}000, 1{,}000{,}000)$?

(3) For what numbers n is $F(n,n) = G(n,n)=n$? List the first dozen.

JAN 2. Robert Bart offers the following extensions to an old problem from Nob. Yoshigahara. What is the smallest positive integer whose square root has a decimal expansion beginning with ten distinct digits? Now consider cube roots instead of square roots. Finally consider ith roots for i = 4,5, . . . ,10.

SEND PROBLEMS, SOLUTIONS, AND COMMENTS TO ALLAN J. GOTTLIEB, '67, THE COURANT INSTITUTE, NEW YORK UNIVERSITY, 251 MERCER ST., NEW YORK, N.Y. 10012, OR TO: GOTTLIEB@NYU.EDU

Speed Department

Mark Astolfi wants you to use Major League rules (with no rainouts) and name five ways a baseball game can go on forever.

Solutions

Y1991. The following solution is from David Brahm, who writes that most of it was worked out by computer, which ran through the 6 possible number orderings, the 5 possible orders of operation, and the 7 possible operators (_, +, -, *, /, ^, and ^-) in each of the 3 positions.

1 = 1^991	20 = 19 + 1^9	80 = (1+9)*(9-1)
2 = 1^99 + 1	27 = 19 + 9 - 1	81 = 91 - 9 - 1
3 = 1 + 9/9 + 1	28 = 19 + 9*1	82 = 91 - 9*1
7 = 9 + 9 - 11	29 = 19 + 9 + 1	83 = 1 - 9 + 91
8 = 9 - 1^19	36 = (1+1)*(9+9)	88 = 99 - 11
9 = 99/11	38 = 19 + 19	89 = (1+9)*9 - 1
10 = 19 - 9*1	63 = 9*(9-1-1)	90 = 11*9 - 9
11 = 19 - 9 + 1	64 = (9-1)*(9-1)	91 = 1^9 * 91
12 = 11 + 9/9	70 = 9*9 - 11	92 = 1^9 + 91
16 = 9 + 9 - 1 - 1	71 = 9*(9-1) - 1	97 = 99 - 1 - 1
17 = 1*9 + 9 - 1	72 = 91 - 19	98 = 1*99 - 1
18 = 19 - 1^9	73 = 1 + 9*(9-1)	99 = 1 + 99 - 1
19 = 19*1^9	79 = 9*9 - 1 - 1	100 = 1 + 99*1

A/S 1. We begin with a bridge problem from Don Boynton who needs to make 7 Hearts against any defense with an opening lead of the Queen of Clubs.

North
♠ 2
♥ 3 2
♦ A K 2
♣ A K 7 6 5 4 3

West
♠ K 10 8
♥ 5
♦ Q J 10 9
♣ Q J 10 9 8

East
♠ 7 6 5 4 3
♥ Q 10 8 7
♦ 8 7 6
♣ 2

South
♠ A Q J 9
♥ A K J 9 6 4
♦ 5 4 3
♣ –

Bart Bramley notes that "this is the famous Vaniva problem, composed in 1928 by the great player Sidney Lenz for a contest sponsored by Vaniva shaving cream." David Gross felt this was a "nice problem with lots of blind alleys." His solution is to win the CA (discard D3) and play the CK. East has a choice of 1) spade discard, 2) diamond discard, 3) ruff. Each of these leads to a different ending.

1) After a spade discard play for a trump coup. Play a low TRUMP on the CK, play the SA and the SQ (and a 3rd spade if West does not cover) ruffing out the SK. Then play the heart double finesse, run the spades and the DA, take a club ruff with East discarding a diamond (best), and play the DK. Finally use a club for the coup and all the tricks.

2) After a diamond discard there is a repeating triple squeeze against West. Discard the S9 on the CK, take a heart finesse, the DA, a heart finesse, and run all the hearts. This will be the position with 1 heart to play:

North
♠ 2
♥ –
♦ K 2
♣ 7 6

West
♠ K 10
♥ –
♦ Q J
♣ J 10

East
♠ 7 6 5 4
♥ –
♦ 8
♣ –

South
♠ A Q J
♥ 4
♦ 5
♣ –

On the last heart West cannot discard a spade, so s/he discards a minor suit stopper while dummy discards C6. Now South cashes the DK and whichever minor suit card West has abandoned, squeezing West in spades and the other minor.

3) After a ruff South can set up the spades via a ruffing finesse and draw trumps. The play is: overruff, SA, SQ (ruffing this or the 3rd round of spades whenever West plays SK), heart finesse, draw trumps and claim.

A/S 2. Thomas Weiss wants you to find a crossword puzzle using as few squares as possible but satisfying:

(1) All 26 letters of the English alphabet are used at least once each.

(2) No proper nouns, abbreviations, contractions, acronyms, or foreign words are used.

(3) All letters are used to form words both horizontally and vertically.

(4) Radial symmetry about the center is achieved, as is common in American crossword puzzles.

I guess the winner is the following 7x7 solution from an anonymous reader who stayed at the Clarion Hotel in Cincinnati.

Q	T	■	A	D	Z	E
U	H	■	C	O	A	X
I	R	K	E	D	■	■
P	U	N	■	G	A	D
■	■	A	B	E	L	E
J	A	V	A	■	E	M
O	W	E	S	■	F	Y

One might object to the use of a British dictionary as representing a foreign language (or using two scrabble dictionaries as representing two foreign

Continued on Page MIT 42

MIT LIFE INCOME FUNDS

COLONEL AND MRS. DAVID BRUCE POWERS

HOME: Tempe, Arizona

CAREER: After graduation, Colonel Powers, '26 CE, moved to California and soon became involved in the motion picture industry, supervising the installation of the first talking motion picture equipment. In 1940, he was called into the service as captain in the Army Corps of Engineers to teach military engineering at Oregon State College. Later transferred to troop duty as battalion commander, he established the 3rd Air Force Camouflage School and served as camouflage officer for the Army Air Forces and as engineer inspector-general for the Western Region. He retired from the Army after service in Korea.

When his wife Doris accepted a position as professor of English at Arizona State University, Colonel Powers enrolled in a course in beginning Russian. He also studied at Indiana University and went on to earn the first Russian degree Arizona State University ever awarded. He published the unique *Dictionary of Russian Irregular Verb Forms* and, with his wife, an English translation of a popular Russian novel, and has translated Russian technical articles. Colonel Powers has been a member of the Society of Motion Picture Engineers and of the Russian honorary society Dobroslovo, and is past president of the Arizona chapter of the American Association of Teachers of Slavic and East European Languages. He is now occupied with mining and ranching in Colorado and, as an avocation, plays the flute.

GIFT OF CAPITAL: David B. Powers (1926) Charitable Remainder Unitrust.

QUOTE: "My MIT education enabled me to pursue a career of great variety and interest. I am glad I can help make it possible for others to have a similar opportunity."

For more information about gifts of capital, write or call Frank H. McGrory or D. Hugh Darden at MIT, 77 Massachusetts Avenue, Room 4-234, Cambridge, Massachusetts 02139-4307; (617) 253-3827.

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DONORS' PROFILE

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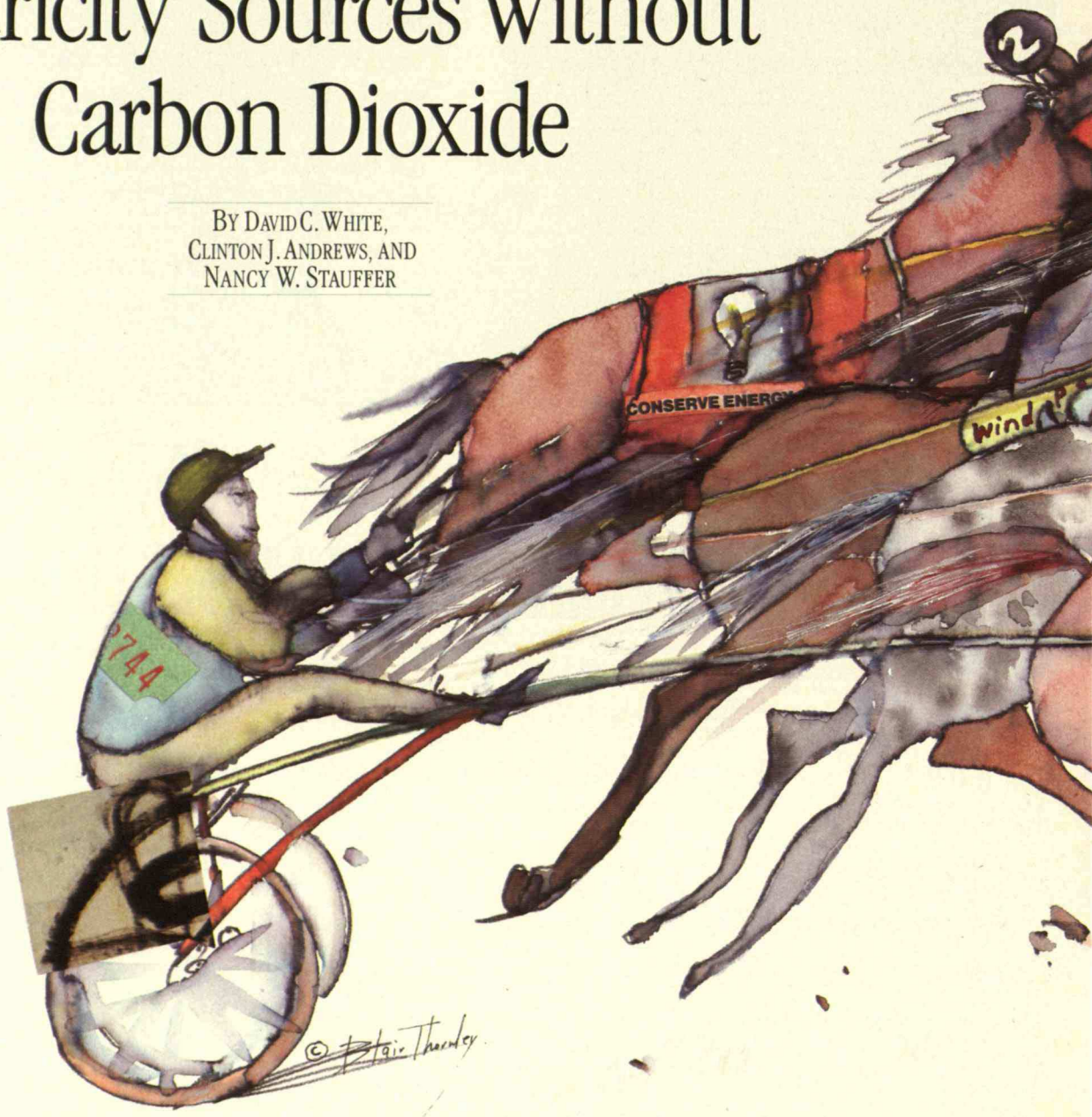
The New Team: Electricity Sources Without Carbon Dioxide

BY DAVID C. WHITE,
CLINTON J. ANDREWS, AND
NANCY W. STAUFFER



Instead of quibbling over how much global temperatures could rise, we should hasten to develop and use a mix of clean technologies.

ILLUSTRATIONS: BLAIR THORNLEY

VARIOUS energy sources have come and gone over the centuries to great environmental benefit. The eighteenth century saw a transition from wood to coal, which reduced deforestation near cities. The middle of the nineteenth century ushered in the era of oil, a change that cleared up much smog. Now there is the need to use still other energy sources, given fossil fuels' emissions of the "greenhouse" gas carbon dioxide, which could cause global warming; atmospheric concentrations of

carbon dioxide have grown by more than 25 percent since the beginning of the industrial revolution.

Investigators worldwide are trying to predict accurately when carbon dioxide concentrations will double their preindustrial value and how that change will affect the temperature of the earth's surface. At present, atmospheric scientists generally believe that carbon dioxide concentrations may double between the middle and late twenty-first century. And many experts think such a doubling will raise average temperatures between 4° and 9°F, although the details regarding what regions will suffer and by how much are still far from clear.

We believe that preoccupation with the precise timing and effects of a doubling of atmospheric carbon dioxide is inappropriate. If the earth's population continues to depend on carbon-based fuels, the amount of atmospheric carbon dioxide will, well before supplies are exhausted, surely rise to many times today's levels, with a significant impact on global climate.

More fundamentally, the world has to start taking measures to get off an unsustainable energy path. Fortunately, there are many potential substitutes to fossil fuels—so many that describing all the choices is too large a task to undertake here. We will therefore focus on a few that could change electric power production, which generates more carbon dioxide than any other sector (more than 35 percent of emitted carbon dioxide in the United States). Also, the U.S. Department of Energy (DOE) expects demand for electricity to continue rising worldwide, especially in developing countries. (As a result, energy conservation by itself is not enough, although it is important and DOE should give more emphasis to research in that area.) Finally, finding clean ways of producing electricity should make the move away from fossil fuels significantly easier in other sectors, such as industry.

When asked about an appropriate R&D strategy for deciding which fossil fuel substitutes should be used—even when limiting ourselves to electricity—we answer as professionals at the race track might: Don't put all the money on one horse. Instead, the world needs to develop and use a mix of technologies. Some favorite options offer reasonable odds and modest payoffs. Others are long shots with potentially great gains.

In screening new technologies, we think it is vital to look not only for environmental benefits but also for improvements in areas such as energy efficiency, robustness, flexibility, safety, and cost. It is also important to consider the time frame for different options.

Using Fossil Fuels More Efficiently

In the near term, fossil fuel-burning power plants will continue to provide much of the world's electricity. Therefore, a first step must be to reduce their carbon-dioxide emissions.

A cleaner, more efficient technology that is already available to replace traditional steam boilers in power plants is the gas turbine combined cycle. The GTCC is cost-competitive and reliable, with dozens of new power plants in the United States and Japan already using it. With a GTCC unit, natural gas or oil burns in a combustion turbine, and the waste heat drives a steam turbine. Since both cycles generate electricity, the total fuel use and carbon dioxide emissions per unit of electricity drop.

In fact, repowering existing plants with GTCC systems can reduce carbon dioxide emissions produced per kilowatt-hour of electricity 25 percent or more. And in many cases the improved combustion efficiency reduces operating costs to the point of nearly offsetting associated capital costs. Moreover, a change from coal or oil—whose composition is high in carbon—to medium-carbon natural gas can cut emissions per unit of electricity another 25 percent.

A transitional technology that can be costlier but useful in countries where coal is abundant, such as the United States and China, is the integrated gasification combined cycle (IGCC). This system heats coal in pure oxygen to obtain combustible gases, mainly hydrogen and carbon monoxide. These gases are cleaned of sulfur and particulates and burned in combustion and steam cycles similar to those used in the GTCC. As with that technology, an IGCC system raises efficiency and lowers emissions per kilowatt-hour of electricity. Studies on repowering plants with IGCC units, however, show that because of their use of coal, the improvements aren't as great as those from installing GTCC systems.

New power plants using either technology would also be efficient. While conventional steam boiler and steam turbine plants typically convert 20 to 38 percent of the energy in burned fuel into electricity (and therefore run at 20 to 38 percent efficiency), GTCC and IGCC plants built in the next 10 years should convert at rates of about 46 and 39 percent, respectively.

By 2000 or soon thereafter, even better fossil fuel-burning technologies may be available. A study commissioned by the Electric Power Research Institute con-

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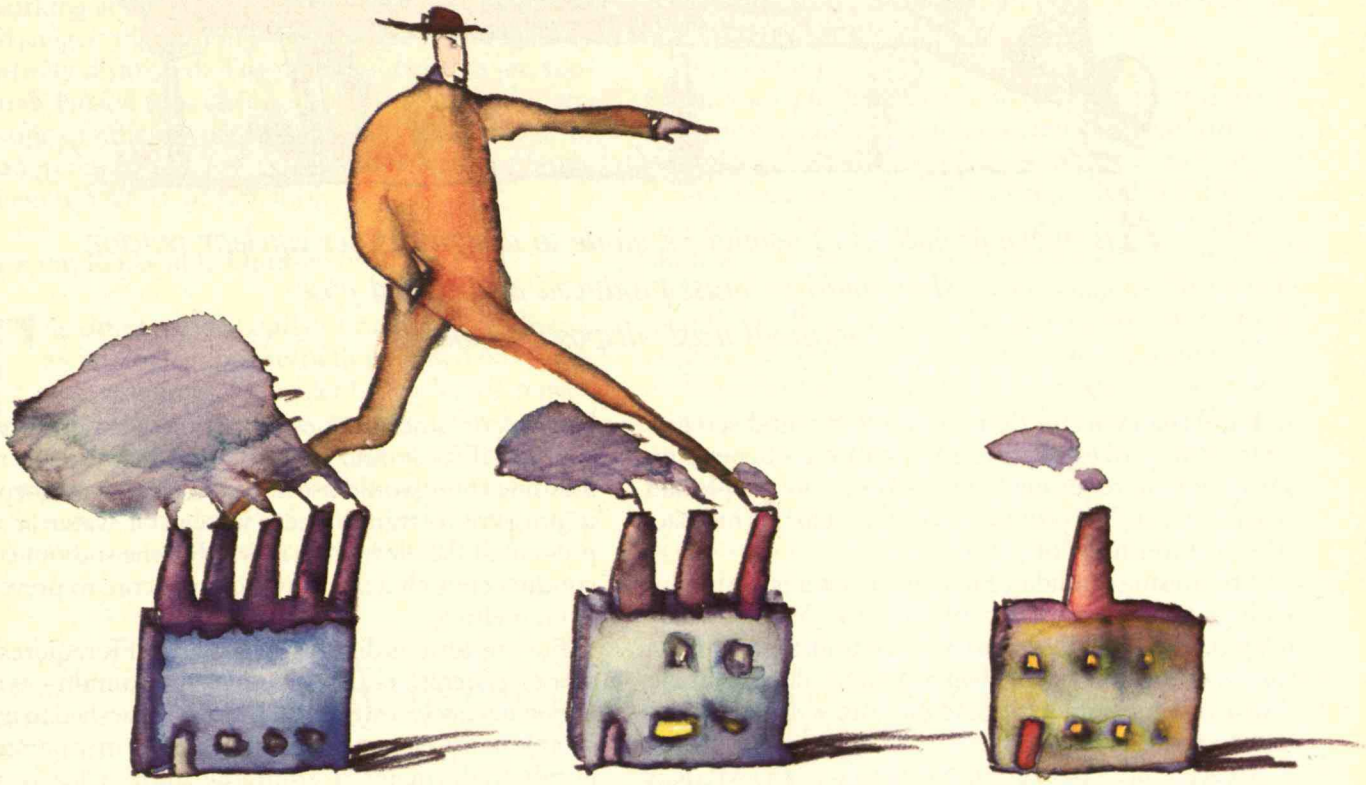
DAVID C. WHITE, Ford Professor of Engineering in MIT's Department of Electrical Engineering and Computer Science, founded the Institute's Energy Laboratory in 1972 and directed it through 1988. He served on the advisory council of the Electric Power Research Institute from 1980 to 1987. CLINTON J. ANDREWS, assistant professor of public and international affairs in the Woodrow Wilson School at Princeton University, studies planning methods for electric utilities. A mechanical engineer, he worked at MIT's Energy Lab as a graduate student. NANCY W. STAUFFER edits the Energy Lab's research newsletter, e-lab.



Ultimately, technologies for generating electricity should not produce carbon dioxide, but first we must reduce CO_2 from fossil fuel-burning plants.

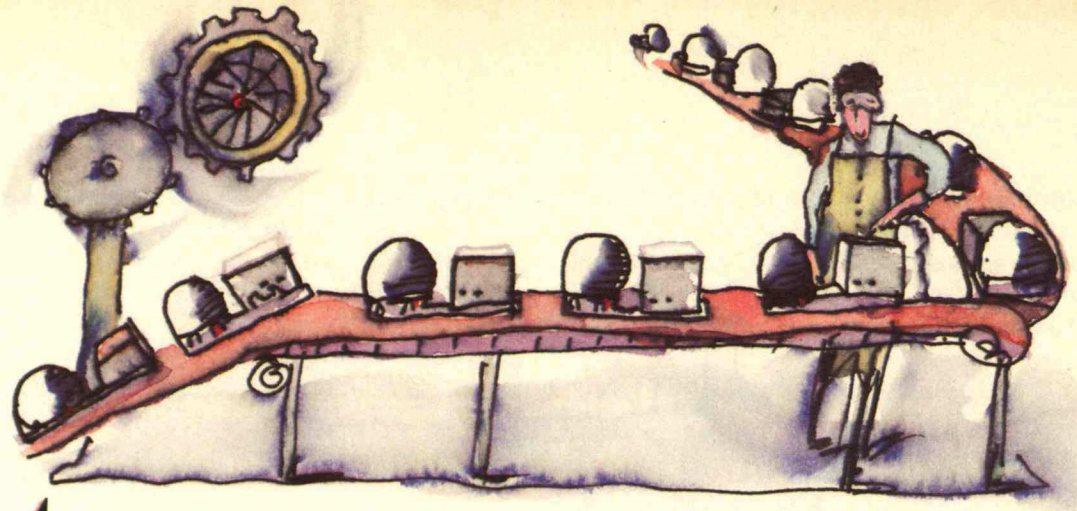
cludes that "humid" turbines, in which a mixture of hot air and steam burn natural gas or synthetic gas from gasified coal ("syngas") in a single turbine, can achieve efficiency rates above 50 percent. And because only one turbine is used, costs are lower than with GTCC or IGCC systems.

Another promising choice is the molten carbonate fuel cell, which generates electricity by electrochemical means rather than combustion. Working with either natural gas or gasified coal, the fuel cell uses an electrochemical process to oxidize hydrogen and carbon monoxide and thereby produce electricity. Energy Research Corp. of Danbury, Conn., and others have built and successfully operated full-scale pilot plants using this technology, achieving conversion efficiencies exceeding 50 percent.

Expanding Carbon-Free Options

Of course, the most attractive technologies for generating electricity are those that do not produce carbon dioxide. One such technology is nuclear fission, which currently is neither politically acceptable nor economically attractive in many countries but is used extensively in France, Japan, and a few other nations.

Most of today's nuclear power plants are variations of the light-water reactor. The LWR consists of a radioactive core surrounded by water that transfers the generated heat to a heat exchanger, which in turn produces steam used to drive steam turbines and generate electricity. Engineers are developing new LWR designs that are simpler, more reliable, and less expensive



An international effort should be made to design a safer nuclear reactor that could be mass-produced and would pose minimal waste-disposal problems.

to build than current designs and that could serve as near-term sources of power. But all LWRs depend on safety systems requiring fast responses from people and machinery, and all produce waste that remains radioactive for thousands of years.

A promising candidate for a safer reactor is the modular high-temperature gas-cooled reactor (MGR), which relies on helium rather than water to transfer heat from the reactor core. Unlike water, helium cannot break down and form an explosive mixture with other elements in the core.

An even more important advantage of the MGR is the packaging for the fuel. Tiny bits of uranium are hermetically encased in carbon and silicon carbide, and the resulting grains are then encased in graphite pebbles or blocks. This produces substances so strong that the fuel cannot escape even if all the coolant is lost, as long as temperatures remain under 1,800 °F. In small reactors—those that produce less than 100 megawatts or so of electricity—natural convection prevents temperatures from ever climbing that high.

The efficiency of MGRs could be impressive—almost 45 percent with a system that is coupled to a gas turbine to produce electricity, according to studies by MIT nuclear engineer Lawrence Lidsky. That design is also simple and could be built using direct extensions of existing technology.

But MGRs would continue to have waste disposal problems. An option that eliminates the worst radioactive waste by recycling it into fuel is the integral fast reactor (IFR). After the primary fuel has been used, technicians can electrochemically process it to separate out the "actinides"—a family of elements that remain radioactive for 10,000 years—for feeding back into the IFR as fuel. Unlike today's nuclear wastes, the remaining waste material would be radioactive for only a few hundred years and could be stored in above-ground bunkers or other devices that could be monitored.

Small IFRs should also be safer than today's reactors since they would use liquid sodium at atmospheric pressure to transfer heat instead of water at high pressure. Like the helium in MGRs, the sodium could conduct enough heat away from the core to prevent it from melting.

But one serious disadvantage of the IFR requires further consideration. One actinide—plutonium—is used in making nuclear weapons; those who wished to might be able to use electrochemical processes to separate the bomb-grade material from the alloy. Clearly, IFR research has to include the development of a management system that could thoroughly safeguard reactors.

Given the advantages and drawbacks of each nuclear option, the highest priority with nuclear fission should be for a cooperative, international program to design a "global" reactor: one that all countries would agree could be located within their borders. In 1990, scientists and environmental activists convened by the National Research Council agreed that this approach would be better than the multiple efforts being pursued by different vested interests. International cooperation in fusion power research could provide a model: the International Thermonuclear Experimental Reactor program involves the United States, Soviet Union, Japan, and the European community.

While the full requirements for a global reactor should be established by international agreement, we think that such a reactor should be cost-effective and capable of being mass-produced; it should pose minimal waste-disposal problems; and it should incorporate passive safety systems and internationally managed monitoring systems that can prevent fuel diversion. The effort might require establishing a vastly more powerful version of the existing International Atomic Energy Association.

Electricity from nuclear fusion, meanwhile, is only a long-term option. For four decades, physicists have unsuccessfully tried to produce power by this means, and we think the idea will not be commercially viable until the middle of the next century. Still, incremental advances such as those recently reported by researchers working at the Joint European Torus reactor in England suggest that fusion power production should not be entirely dismissed. The potential benefits are substantial. Fusion uses cheap, abundant fuel and offers the hope of efficient production, and compared with fission, reduced waste disposal and less risk of large, accidental releases of radiation.

Improving Renewable Options

The other major family of carbon dioxide-free technologies consists of those based on renewable resources. Consider hydroelectric power. The technology is mature: fully 20 percent of the electricity generated worldwide comes from hydroelectric plants. Electricity costs of hydropower are competitive with those of fossil-fuel plants, and hydropower has added attractiveness in that dams enable energy to be stored for later use. Unfortunately, suitable rivers occur in only a few locations, and many of the remaining undeveloped sites are in countries where financing would be difficult. In other countries, such as Canada, opposition prompted by reasonable concerns about indigenous cultures and ecosystems has slowed the development of many technically feasible hydropower sources.

Then there are the solar technologies. Today only a few utilities have integrated into their energy grids photovoltaic systems, which rely on semiconductors to convert solar radiation into electricity. About 25 megawatts of photovoltaics are up and running in the United States, largely in California. In regions with diffuse sunlight, photovoltaics are best suited at this time for applications such as pumping water, which require fairly small quantities of electricity. The current cost of making utility-grade photovoltaic systems and operating them in less than ideal locations exceeds 30 cents per kilowatt-hour. (The average cost of generating electricity from coal-fired power plants was about 3 cents per kilowatt-hour in 1989.)

But with improvements in designs, photovoltaic efficiency rates continue to rise and costs continue to

Transmitting Electricity More Efficiently

SINCE the 1970s, dramatic improvements have occurred in the efficiency with which residential, commercial, and industrial users of electricity can convert raw kilowatt-hours into energy services. Residential air conditioners, for example, can today cool 30 percent more efficiently than in 1978.

A significant barrier to fully realizing such changes, however, is the fact that millions of consumers own such equipment. Persuading all those individuals and companies to upgrade equipment requires subsidies, giveaways, or energy-efficiency standards imposed by government or utilities. While some of these steps are being taken, they encourage the retirement of existing equipment slowly.

Another option is to improve the efficiency of electric power transmission. About 10 percent of the electricity that passes through transmission lines today does not get delivered. But there are ways to reduce that loss. For example, utilities could more widely use "reconductoring"—increasing the size or the quantity and configuration of the wires—to raise the capacity of existing transmission lines and to reduce losses.

Utilities are also starting to develop networks that connect direct-current (DC) lines for long-distance transmission to existing alternating-current (AC) lines for short distances. For instance, the New England Power Pool has installed a 250-mile-long DC link for importing Canadian electricity. Given the same size wire and the same current, DC loses less electricity than AC because of a lower resistance to current flow. Converting DC into AC—the current used by U.S. appliances—is expensive, but prices for the solid-state conversion devices have been dropping.

We are less enthusiastic about the near-term possibilities of two ideas popular in environmental circles: "environmental dispatch" and "environmental wheeling." The first concept is similar to the least-cost dispatching used today, in which production units are networked so that those with low operating costs run most frequently. By modifying the dispatch logic, utilities could run their cleanest generating units most often. But that would reduce the reliability of most of those plants, since they typically have not been designed to run constantly. Meanwhile, environmental wheeling refers to large consumers using utility lines to transport electricity purchased directly from independent, clean generating sources. In the short term, most utility networks could not efficiently handle customers switching to independent generators, as various lines would then encounter underloading or overloading.

A longer term approach would be to replace portions of the transmission network with superconductors. That change would raise conductivity and hence capacity on long-distance lines and would dramatically reduce current losses. This idea requires the development of appropriate high-temperature superconducting materials and cost-effective methods of cooling them, since even "high-temperature" superconducting materials require significant refrigeration. The technology is not likely to be commercially available for several decades, but a significant investment of research time and money is warranted. ■—*David C. White, Clinton J. Andrews, and Nancy W. Stauffer*

Cold water could be run through hot, dry, fractured rock below the earth's surface and the resulting steam recovered.

drop. Assuming that these kinds of advances maintain their current pace, projected costs for grid-connected systems by the mid- to late-1990s are between 10 and 15 cents per kilowatt-hour.

If mass production leads to more dramatic cost reductions, photovoltaics could play an important role in meeting future electricity demand. Recently, investigators at Texas Instruments developed a way to make impure silicon into small spheres in which the impurities are concentrated at the surface, leaving semiconductor-grade material in the core. Making photovoltaic cells with these spheres is faster and less expensive than producing cells by traditional techniques. The new method could result in economical mass production of the large, photovoltaic arrays needed to capture sunlight.

While demand for photovoltaics is not yet large enough to warrant mass production, the situation could change within five years. Many utility companies—even in New England, with its substantial cloud cover—are examining whether adding photovoltaic systems to homes and businesses could help meet customers' demands during peak daytime hours.

Like photovoltaics, solar-thermal systems today tend to be fairly expensive—8 to 10 cents per kilowatt-hour—because there is not much demand for them and they are therefore not mass-produced. The use of these systems is limited to locations enjoying substantial amounts of bright, direct sunlight. California's Mojave Desert is home to the largest commercial U.S. solar-thermal plant, a 150-megawatt plant that relies on trough-shaped, parabolic reflectors to focus solar radiation onto pipes containing water, which turns into steam that drives electricity-generating turbines.

Current research could lead to solar-thermal costs dropping to 5 cents per kilowatt-hour within the decade, according to a report by the U.S. national laboratories. It should be possible to use less expensive turbines to produce electricity (in particular, Stirling engines, which rely on hot gases such as air instead of steam) and to substitute materials such as mylar-plastic membranes for the heavy, costly mirrors now used to track the sun. With further advancements still, the report states, solar thermal systems could within 20 years carve out a select niche in our portfolio of electricity-generating technologies.

Utilities have also installed more than 1,500 megawatts of wind turbines in the western United States, reducing costs and the frequency of power failures. In locations with winds of sufficient persistence and strength (averaging about 15 miles per hour), wind power competes economically with traditional power production methods. The newer wind farms in Tehachapi Pass, Calif., generate power at about 8 cents per kilowatt-hour.

The problem with wind power is that winds can vary. On the island of Hawaii, where wind turbines represent about 10 percent of the total generating capacity, fossil fuel-fired generators struggle to provide enough power during calm periods. The Electric Power Research Institute has been supporting research on how to set up enough backup systems without building in so much redundancy as to defeat the purpose of wind power. Princeton University investigators are analyzing one promising path: the use of gas turbines that could operate at part load until they received information that winds were lessening, at which point the turbines would quickly switch to running at full load.

Finally, two geothermal technologies offer alternatives to fossil fuels. Hydrothermal power, an option already used commercially on a small scale, draws on reservoirs that lie no more than about a mile underground and contain pressurized steam or water as hot as 690°F. Many more such reservoirs are available, although exploitation of this resource will largely be constrained to volcanically active regions of the world, especially the Pacific "Ring of Fire" and the Mediterranean area. Reservoirs with lower temperatures, such as some near the Mississippi delta, offer the compensation of high concentrations of pressurized methane, another energy source. While local environmental impacts may lead to siting problems in some places, we think that hydrothermal power should be fully exploited until cheaper carbon-free options are available.

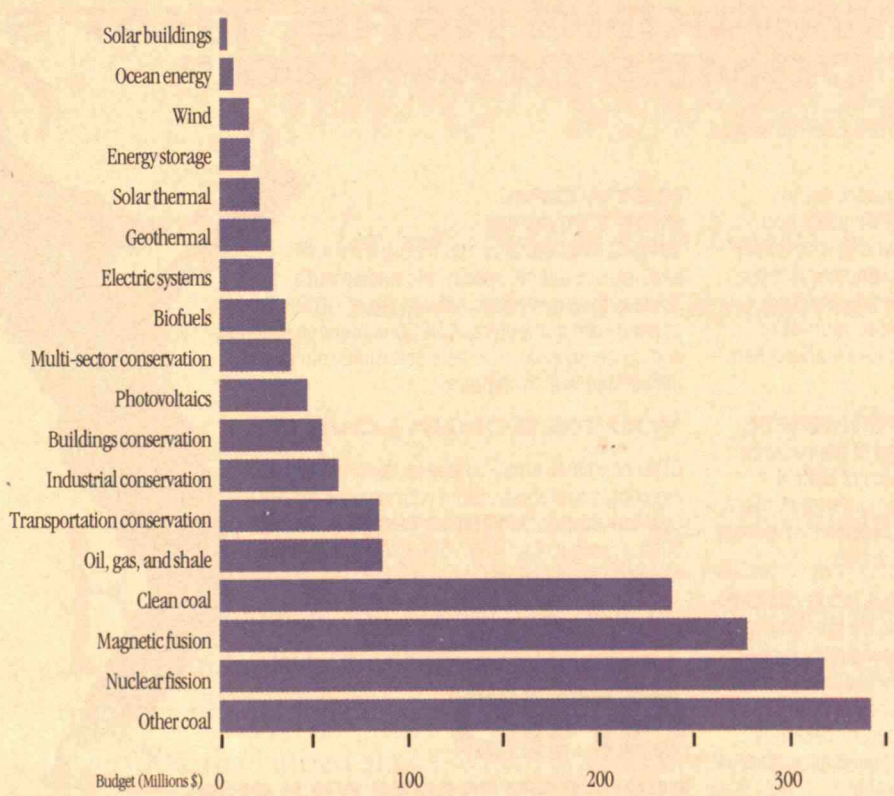
Hot dry rock is another promising geothermal technology that could be commercialized in the next decade or two. Hot rock that is either impermeable or lies near no groundwater is found in many places worldwide, two to four miles below the earth's surface. Conceivably, this rock could be fractured, cold water introduced, and the resulting heated water or steam recovered. Economic modeling studies at MIT suggest that costs could be as low as 5 to 9 cents per kilowatt-hour at some reservoirs. Researchers at Los Alamos National Laboratory in New Mexico are field-testing operating techniques.

Of course, finding new ways to produce electricity won't end all the carbon dioxide emissions that come from the burning of fossil fuels. For example, transportation contributes 32 percent of all the carbon dioxide emissions in the United States. But even here, electricity could make a substantial difference. Given the availability of a clean, economic source of electricity, reasonable options might include battery-operated vehicles (particularly if users relied on a network of "battery stations" instead of overnight battery recharging) and electrified guideways, in which inductors buried in the roadbed would deliver electricity to "pickups" in vehicles. And in some cases, the amount of carbon dioxide emitted by the manufacturing sector, which generates 20 percent of total U.S. carbon dioxide emissions, could drop by changes made to industrial processes using electricity. For example, carbon dioxide emissions drop one pound for every five pounds of copper produced by electric induction instead of using a furnace.

Encouraging Technological Change

It is time to stop quibbling about when atmospheric carbon dioxide will double and how much the temperature will rise. Instead, the United States should take advantage of options to reduce carbon-dioxide emissions and energy costs, and it should embark on the decades-long program needed to develop and commercialize other carbon-reduced and carbon-free energy technologies. We will have to do it eventually, we will be able to do it cost-effectively, and we ought to begin now—with a balanced, rational, and sustained program.

AUTHORIZED R & D BUDGET ON ENERGY SOURCES (F.Y. 1991)



The authors argue that the U.S. Department of Energy should spread its research budget more uniformly than in fiscal year 1991, when most funding was directed to non-renewable energy sources. The figure excludes related environmental and basic-science research.

CHART SOURCE: CLINTON J. ANDREWS

The limited money available for research on alternative energy sources should be divided among a variety of near- and long-term solutions. For the short term, the most important task is commercializing well-developed technologies. For the longer term, several technologies offer great potential. Research funding for advanced nuclear fission, fusion, photovoltaics, and hot dry rock should be made more uniform, without ignoring efforts to improve wind and solar thermal technologies. The international research effort on fusion should also continue, but more members of the world community should share the cost of this exceptionally expensive, risky effort.

Identifying an effective federal research program on new energy sources is relatively easy—indeed, a recent congressionally sponsored study prepared by the National Academy of Engineering came to similar conclusions as those we've offered. The hard part has been selling recommendations to DOE, which is forced to treat research funding as a pawn in the give-and-take of politics. Another Academy study should be undertaken, in this case to propose a process that involves members of the private sector and government in choosing an ultimate strategy.

As for commercialization of new energy-production technologies, the nation needs to recognize that market forces alone will not encourage use of clean technologies. Today's energy prices ignore environmental costs. Moreover, during the past two decades, regulations in the United States and some other industrialized countries have been biased against new power plants, leaving in place outmoded electric-supply systems. We should remove those biases and consider policy options such as "carbon" taxes or limits on carbon-dioxide emissions, possibly with market-oriented features such as tradable permits that enhance economic efficiency.

But even government limits and taxes would not be enough to encourage utilities to turn over equipment rapidly. Energy producers need to recognize and consider the environmental impacts of their plant investments—or lack of investments—and they must accept the necessity of replacing power plants that are old with ones that are environmentally sounder. The public, for its part, must adjust its "not-in-my-backyard" mind-set to accommodate such improvements. Combined with a balanced research strategy, new perspectives on the part of government, industry, and the public could raise our chances of inventing a way out of the fossil-fuel era. ■

You Don't Have To Be A Rocket Scientist . . .

BY JOHN DOBLE
AND
AMY RICHARDSON

The public can participate thoughtfully in policy decisions with tough underlying scientific issues.

FROM genetic engineering to the Strategic Defense Initiative to the destruction of the ozone layer, issues packed with scientific and technological complexity have been rapidly appearing on the public agenda. Policymakers who decide what action to take on these issues receive background technical information. But in a democratic society like the United States, where does that leave members of the public,

ILLUSTRATIONS: BLAIR THORNLEY

The lack of detailed scientific knowledge does not block most people from carefully assessing scientific issues.

who on the whole are woefully lacking in scientific literacy?

Some observers believe that reasonable public involvement in decision making about scientific issues is impossible. Jon Miller, a political scientist at Northern Illinois University, argues that only the roughly 20 percent of the public who keep informed about scientific matters can participate effectively.

Dorothy Nelkin, a sociologist at New York University, thinks many government agencies share Miller's view. Thus, she says, they work to avoid "endless demands from private interests or from self-appointed public representatives who lack the technical knowledge to assess decisions." But, she adds, public involvement is inevitable. Citizens will demand a place at the table where political decisions about scientific issues are decided.

That is the way many politicians and scientists see the public's role: a case of the impossible versus the inevitable. But the dilemma isn't real. A study that the Public Agenda Foundation conducted with the Charles F. Kettering Foundation suggests that people who don't ordinarily keep abreast of scientific issues can quickly learn about their critical aspects and choose reasonable policy options. By and large, participants in the study made the same choices as a group of scientists. Moreover, the participants' positions made sense even when they differed from those of the scientists. We conclude that thoughtful public involvement in decision making about scientifically complex issues is not the impossible task that some suppose.

Quick Learning

Our study focused on two controversial scientific topics fraught with conflicting claims by experts and inconsistent ideas or misunderstandings among the public: solid waste disposal and the threat of global warming from the greenhouse effect. The two topics contrast in that solid waste is a local issue and an immediate problem, while global warming is international and long-term.

The research involved a group of 402 people from four cities in the principal regions of the country—the Northeast, Midwest, West, and South. In sex, race, age, education, and income levels, the group was representative of the overall population.

The participants in each city, who did not know the focus of the research in advance, met in a single three-hour session. First they filled out a questionnaire about the issues. Some of the questions concerned scientific facts, such as whether emissions from automobiles contribute to the greenhouse effect. Other questions related to policy making: did a participant believe, for instance, that utilities should burn less coal, even if many coal miners would lose their jobs?

Next the people watched a 20-minute film that gave a balanced description of one of the issues and pointed out the aspects on which scientists disagree. The film also presented an array of possible solutions, with arguments pro and con. The participants then broke up into moderated groups of about 15 to discuss the issue for 45 minutes.

We asked the "panels" to think of themselves as members of citizens' committees advising their mayor or Congress. We focused on helping people understand general concepts instead of technical details. On global warming, for example, we described the greenhouse effect, pointing out how higher temperatures might affect rainfall and flooding. But we did not explain the atmospheric chemistry in-

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volved. On both issues, we also stressed that there were no villains or scapegoats, no miracle solutions or technological quick fixes on the horizon. We pointed out that the problems have arisen largely from things we do every day, such as driving cars and using disposable paper and plastic products. Explaining that there were no right or wrong policy answers, we asked the participants to decide what was best for their community and country.

After the discussion, the panelists watched a short film about the second issue and then held a similar discussion about that topic. Finally, they filled out the questionnaire again. This enabled us to compare their understanding and policy ideas before and after their quick education and discussion.

By mail, meanwhile, we interviewed 418 leading U.S. scientists whom we had picked at random. While not necessarily experts in global warming or solid waste, they do deal routinely with such concepts as uncertainty, probability, and hypothesis. We posed the same policy questions to the scientists, to compare their perspective with that of the panelists.

Resolutions on Two Problems

The results of the citizens' panels suggest the outlines for a national resolution about both solid waste disposal and the threat of global warming.

In brief, the lay participants favored an integrated approach on solid waste. A majority called for reducing the volume of disposable products and packaging. They wanted widespread mandatory recycling, with taxes and incentives to raise both the demand for and the supply of recycled paper. They thought that more incinerators and landfills should be built only as a last resort and with the strictest environmental safeguards.

Most of the panelists supported a number of measures for reducing the threat of global warming from carbon dioxide emissions. People thought the United States should lead international efforts to address the problem. They favored more spending on mass transit and a 40-miles-per-gallon standard on new cars by the year 2000. They decided that the government should give tax breaks to homeowners and industries that add insulation, and to builders who use passive solar energy. They also felt that the government should boost funding for solar energy research, as well as require utilities to burn less coal and businesses to boost fuel efficiency. Finally, many panelists said that more trees should be planted and the number that can be cut each year reduced.

Among the steps the participants opposed were taxing two-car families, banning gas guzzlers, taxing or regulating home energy use, drilling for more natural gas offshore or in national parks, and rationing gasoline or phasing in over 10 years a dollar-per-gallon gas tax.

Intelligent Counsel

Our conclusion from this exercise is that the public as a whole—not just those who are attentive to science—can intelligently assess scientifically complex issues, even when experts are uncertain.

One reason for this verdict is that the panelists learned a great deal in a short time. The number of people who answered "not sure" to questions about two alternatives for disposing of solid waste—reduction of source materials and incineration—dropped 20 percent between the two tests. And knowledge of factors contributing to the greenhouse effect rose dramatically. For example, the number of participants saying the use of coal by utilities is a factor increased from 60 to 91 percent, while the number say-

After teaching general concepts about two science-based policy issues to laypeople, we found that their perspectives were often remarkably similar to those of scientists.

ing that "people heating and cooling their homes" is a cause grew from 50 to 89 percent. Subjective measures bolster this interpretation: more than 80 percent said their understanding of each topic rose "somewhat" or "a lot" over the course of the meeting.

Another reason for optimism is that the policy ideas the participants expressed in the follow-up tests were often remarkably similar to the views of the scientists. Majorities in both groups stood together in favoring or opposing 19 of 25 measures to reduce the level of greenhouse gas emissions.

For example, 79 percent of the scientists we queried favored upgrading the miles-per-gallon standard to 40 by the year 2000, even if it would lower performance and raise new car prices. Some 75 percent of the panel members held this opinion in the follow-up test, a 20-point rise from the first test. Similarly, in the first test only 36 percent of the participants thought it would be a good idea to build more solid waste incinerators. But in the follow-up test—after learning about the size of the problem—70 percent said more incinerators should be built as a last resort. Seventy-nine percent of the scientists took this position.

Finally, the participants were motivated to do the work necessary to reach thoughtful decisions. We think this stems not only from their feeling that they had a right to be involved in making the decisions, but also from the fact that they had been told that their views were important and would be heard.

Our research leads us to believe that a lack of detailed scientific knowledge does not block most people from carefully assessing complex issues. More important is a framework for presenting the policy options on a certain issue, along with their trade-offs and uncertainties.

When the public disagrees with scientists, the difference may stem from factors other than science literacy.

Indeed, it is not the scientific elite who typically decide what to do about issues with scientific aspects; it is leaders who are not experts. The edge that policymakers have is in the expert advice they receive. We therefore gave the participants a picture of each issue as policymakers would see it. After all, decisions about whether to implement a mandatory recycling program or build a nuclear power plant are ultimately political.

We also believe that when the public disagrees with scientists, the difference may stem from factors other than science literacy. For example, opposition to using more nuclear power did not decline between the first and the follow-up tests. While 45 percent of the public participants opposed nuclear power in the first test, 46 percent opposed it in the follow-up test. Between the two questionnaires, our film stated that global warming is potentially catastrophic, that fossil fuel use is the primary contributor to greenhouse emissions, that nuclear power gives off no such emissions, and that nuclear power is widely and safely used in Europe and Japan.

Why did opponents maintain their stance? During the discussion of the global warming threat, panelists talked about Three Mile Island and Chernobyl, the problems of safely disposing of radioactive waste, and government cover-ups of waste leaks at Washington state's Hanford site and other nuclear weapons production plants. Opposition to nuclear power was not based on a Luddite-like fear of nuclear technology. Instead, opponents felt that the safety record of the government and the nuclear power industry was so shoddy that nuclear power should be ruled out. This is a judgment that better scientific information will not change.

Of course, scientists are also familiar with these concerns. But they probably looked at the issue differently. Consider this analogy: In assessing an automobile's safety, experts might look for such features as air bags, seat belts, and radial tires. But no matter how many safety features it has, a car is unsafe if the driver is incompetent. With nuclear power, the scientists may have focused on the technical aspects, while the panelists looked at the "driver."

As an arbiter on tough, science-laden policy questions, the public is not different from a jury in a court of law. A jury consists of people who are experts neither in the substance of the case nor trained in the law. Yet a jury makes life-and-death decisions that are typically thoughtful and often wise on the most intricate legal issues. Asked to shoulder responsibility and consider the public interest, most U.S. citizens will, we believe, react rationally and according to their sense of the common good. ■

A view from Washington

Nuclear Waste: Steady Progress to a Known Solution

Americans live in fast forward. We prize quick results and easy answers, fast food and instant gratification. I sometimes wonder if we are losing our capacity to understand and manage complex issues and difficult problems that demand steady, persistent, long-term attention.

This certainly seems to be true of nuclear waste.

I cannot count the number of people who have told me that they would gladly support construction of new nuclear power plants to meet our growing need for electricity...if only we knew what to do with the nuclear waste.

The fact is, we have known what to do with nuclear waste for over 30 years, long before the world's first nuclear power plant started up at Shippingport in Pennsylvania, in the late 1950s. We knew then that we would isolate the waste deep underground, in stable rock formations, locked away behind carefully engineered barriers, and monitored to ensure that radioactive material does not escape.

Thirty years of study and analysis have confirmed the wisdom of this approach. It is endorsed without question by leading independent scientific organizations around the world, including the U.S. National Academy of Sciences, the American Physical Society, the International Atomic Energy Agency, the U.S. Environmental Protection Agency, and the Congressional Office of Technology Assessment. "There is no scientific or technical reason to think that a satisfactory geological repository cannot be built," said the National Academy of Sciences' National Research Council last year. "There is a strong worldwide consensus that the best, safest long-term option for dealing with high-level waste is geological isolation."

Where does the U.S. nuclear waste program stand? In 1987, Congress ordered the U.S. Department of Energy to conduct a comprehensive scientific evaluation of Yucca Mountain, a remote spot in the Nevada desert, as a possible site for safe, permanent nuclear waste disposal. Yucca Mountain seems to have the necessary requirements. It's isolated. The climate is arid. And the area seems geologically stable.

The Energy Department is conducting a massive scientific investigation of Yucca Mountain, which will determine whether it is a suitable site for nuclear waste disposal.

This may be the most comprehensive, careful and systematic assessment of a piece of real estate ever conducted. It will require 10 years of on-site and laboratory investigations and analyses, cost more than $4 billion, and involve some 500 scientists and engineers. And at every turn, the scientific work is monitored by independent agencies, including the National Academy of Sciences, the Nuclear Waste Technical Review Board (an independent group of experts appointed by the President), the U.S. Nuclear Regulatory Commission, the Environmental Protection Agency, the General Accounting Office and the state of Nevada.

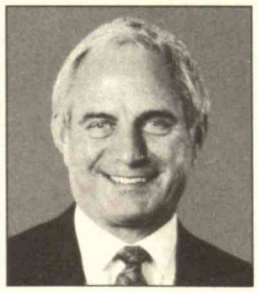
If the scientists conclude that Yucca Mountain is suitable for nuclear waste disposal, we can all have complete confidence in that decision, and in the process that produced it.

It is true that the U.S. nuclear waste program and the work of Yucca Mountain have experienced setbacks. The Energy Department did not have a permanent director for the program from 1987 until 1989, and this lack of leadership caused delays. The Department's choice of a contractor to manage the program day-to-day was challenged in court, which led to further delays. And the state of Nevada has delayed the scientific work at Yucca Mountain, by refusing to grant necessary permits.

Fortunately, the Energy Department program now has a permanent director and a prime contractor, and all the state's challenges have been struck down in court. The U.S. nuclear waste program is now firmly on the right track.

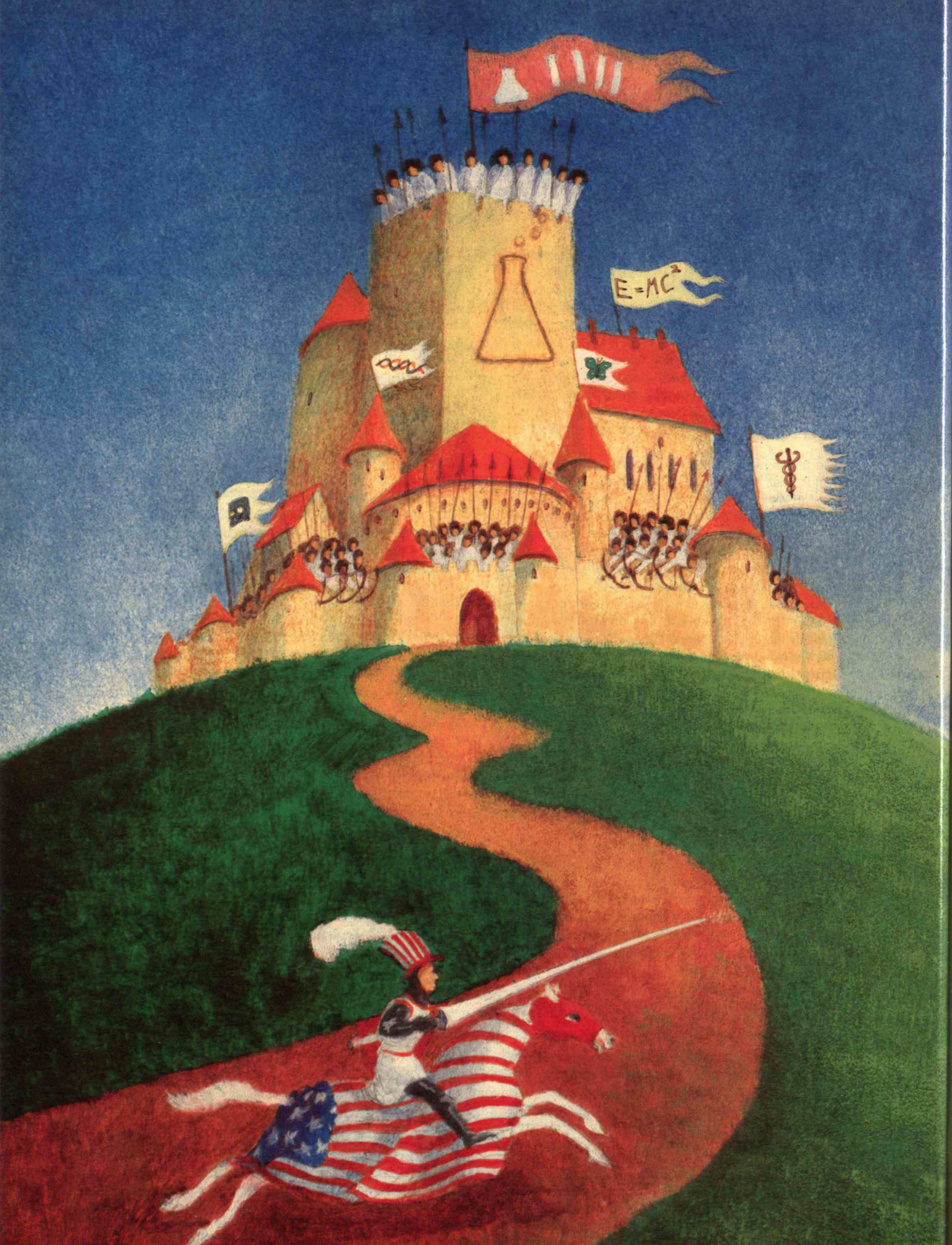
Let us remember that periodic setbacks are almost inevitable in any program as lengthy as this one. There will probably be occasional reversals in the years ahead, but ingenuity and persistence will overcome those, too.

Nuclear waste disposal is a serious undertaking. It deserves careful, methodical treatment. This is no place for quick and easy answers. You cannot see a glacier's movement with the naked eye, but that does not mean the glacier isn't moving. The process of evaluating possible sites for nuclear waste disposal is slow because it should be deliberate and careful. Progress will not always be visible from day to day, or even from year to year. But don't make the mistake of assuming there is no progress.



Phillip Bayne
President and CEO
U.S. Council for Energy Awareness

A View From Washington is a series of essays sponsored by corporations and associations. The views expressed do not necessarily reflect those of the magazine.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John Dingell: Dark Knight of Science

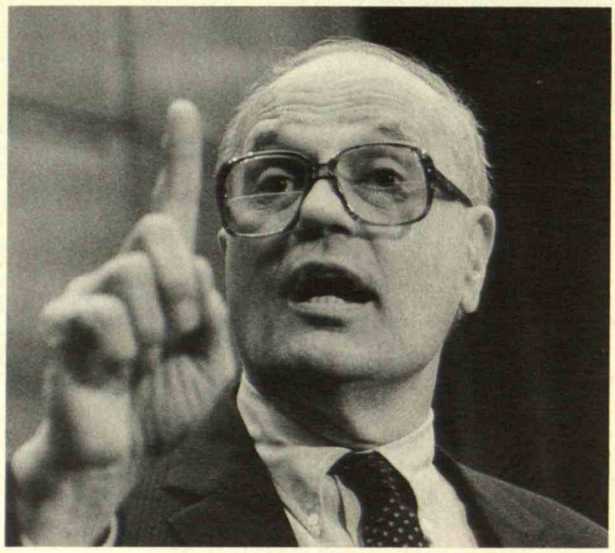
BY WADE ROUSH

While scientists cringe, one congressman crusades to rout misconduct in U.S. research universities.

THE SOCIAL CONTRACT between science and government established after World War II promised researchers ample budgets and a large measure of independence in return for a constant flow of advances. Today that contract is under strain. According to a perception now spreading from the laboratory to the popular press, U.S. scientists' reputation for integrity and productivity is being undone by accusations of fraud from a hostile and miserly Congress. "Science under Siege," trumpeted the cover of *Time* magazine last summer.

Spearheading the alleged congressional assault on the research establishment's status quo is Rep. John D. Dingell, Jr. (D-Mich.), chair of the House Energy and Commerce Committee as well as its Subcommittee on Oversight and Investigations. Dingell has taken on such prominent scientists as Nobel Prize–winning biologist and Rockefeller University president David Baltimore,

ILLUSTRATIONS: KEVIN HAWKES



Rep. John Dingell says many scientists have developed an overblown image of their role in society. Calling himself "the last of the New Dealers," the 18-term Michigan Democrat says he is trying to assure that "when the government pays for research, it ought to be done truthfully."

Stanford president Donald Kennedy, and the new director of the National Institutes of Health, Bernadine Healy. All three crossed Dingell in hearings conducted by his subcommittee—and all three are still licking their wounds.

"In the last 40 years there was nothing comparable to the kind of conflict that has arisen" over Dingell's activities, says Harvard biologist John Edsall, a senior statesman of science. As even the jewels in the crown of the research establishment—schools like Stanford and MIT—come under scrutiny by legislators for malfeasance, science's claim to a special position in society is being questioned.

Many scientists fear that Dingell's probes are veiled attempts to assert congressional control over the profession. But the 18-term congressman insists he treats science no differently than the other institutions, from the defense industry to the White House, that have come under the subcommittee's powerful lens. He says scientists' feelings of persecution, displayed in their defensive behavior as witnesses, are unwarranted.

"The tactics of the people we invite are always the same," he told *Technology Review*. "They attack the subcommittee, they attack me, and they point out that they have some special responsibility that can't be intruded upon by the federal government." To Dingell, this reaction is a sign that scientists have developed an overblown image of their role in society.

A growing minority within the scientific community agrees with Dingell. The real threat, these scientists say, is not coming from the government. Instead, the siege is from within: rampant misunderstanding of the intent of congressional investigations is damaging the partnership between science and government beyond easy repair. "The scientific community has come away from this with a misapprehension—that Dingell is the enemy," says Harvard's Nobel Prize–winning geneticist Walter Gilbert. The damage to science is not being caused by Dingell, he says, but by leaders within the scientific community such as Kennedy and Baltimore.

The issue in the clashes between Dingell and the scientific community is not whether fraud or misconduct occurs in science—which is, after all, a human enterprise—but whether scientists, universities, and funding agencies like NIH can respond adequately when they do happen. Are allegations of misconduct thoroughly investigated? Can scientists judge each other without conflicts of interest? Are whistle blowers protected from reprisals? Dingell says that he wants scientists to police themselves. He construes their failure to do so as an invitation to step in on behalf of the taxpayers who are footing the research bill.

The Michigan Muckraker

John Dingell directs the largest staff with the largest budget in Congress. More than 40 percent of the legislation handled by the House passes through his committee, which has jurisdiction, in the words of the *National Journal*, over "anything that moves, burns, or is sold;" its domain includes national energy policy, interstate trade, the stock market, and biomedical research.

Dingell is an "old-fashioned, populist-style investigator looking for the malefactors in society" says Robert Rosenzweig, president of the Association of American Universities (AAU). In the early 1980s, Dingell's investigation of enforcement practices at the Environmental Protection Agency led to the resignation of administrator Anne Burford and the perjury conviction of assistant administrator Rita Lavelle. In the mid-1980s, his subcommittee made the Navy's $640 toilet seat a symbol of waste in defense contracting, and it uncovered attempts by General Dynamics, maker of the Trident submarine, to bribe Navy officials. *Common Cause Magazine* recently singled out Dingell's subcommittee as the exception in a Congress that is on the whole "allowing waste, fraud and abuse to go unchecked throughout the federal bureaucracy."

Dingell calls himself "the last of the New Dealers," believing that it is the role of the government—particularly the Congress—to guard the public against concen-

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PHOTO: UPI/BETTMAN

trations of power. He says his subcommittee is "just trying to see that the relationship is back to the way everybody thinks it should be: when the government pays for research it ought to be done, and it ought to be done truthfully."

Those who receive dreaded "Dingellgrams"—Washingtonian for an invitation to appear before the subcommittee—have good reason to fear for their reputations. Dingell's approach differs dramatically from the quiet and collegial manner in which scientists prefer to settle their internal disputes. "It's not always scrupulously fair," says the AAU's Rosenzweig. "The revelations and the way they've been treated in the press have contributed to a much broader feeling that there's something fishy about these powerful universities."

Dingell's usual tactic for exposing wrongdoing is to capitalize on tips from disaffected insiders. Information from career EPA officials helped topple Burford and Lavelle. And in the Baltimore affair, Dingell seized on the accusation by young immunologist Margot O'Toole that Baltimore colleague Thereza Imanishi-Kari had doctored data published in the biology journal *Cell*. Dingell's next step is to call in the media. "It's characteristic of his investigations," says Rosenzweig, "that in the week or two leading up to a hearing there is a series of leaks to friendly press of some of the revelations that the hearings are supposed to disclose, the idea being to build up press interest in the hearings." Such leaks preceded both the Baltimore and Stanford hearings.

Once a hearing is underway, witnesses must beware. "The friendly witnesses are treated well, and the targets of their investigations are not," says Rosenzweig. "There's a lot of tough talk, a certain amount of bullying." In a typical opening parry, Dingell threatened last August to have NIH director Healy fired if she proved uncooperative. (Dingell had accused Healy of interfering with the Baltimore investigation.) Dingell applies his skill as a former prosecutor to trip up witnesses with a relentless battery of questions. On occasion, the committee has engaged in questionable means to its ends, as when a staff investigator covertly taped a private conversation that Dingell later used to discredit a witness.

As when he hunts wild game, Dingell enjoys cornering witnesses in his hearings: "I always use the biggest rifle or the biggest shotgun I can take. When I shoot something, I want it to go down."

Because a subcommittee hearing is not a court of law, questions of due process sometimes take a back seat. Dozens of scientists signed a letter to *Nature*, for example, complaining that Imanishi-Kari had been given little opportunity to review the evidence gathered against her by investigators at the NIH's Office of Scientific Integrity, or to refute directly the charges that she faked immunological experiments while at MIT in 1986.

"I'm not paid to be a nice guy," an unapologetic Dingell told the *New York Times* last year. With his booming voice, imposing six-foot, three-inch frame, and a jutting lower lip, the 65-year-old Dingell projects the image of a county sheriff who's just caught a Porsche speeding at 90 mph. This time around, it's scientists who are paying the ticket.

"Dingell is formidable not because he has more friends than anyone else, nor because he is more skilled," says Secretary of Agriculture Edward Madigan (R-Ill.), a former member of the Energy and Commerce Committee. "His strength comes from a bulldog determination not to let go. He is the most tenacious member of Congress." Dingell also relies on a fiercely loyal staff. Particularly feared by scientists is research analyst Peter Stockton, Dingell's chief aide in the investigations of Baltimore, Healy, and others. Rough-speaking and hardened by years of Naderesque detective work, Stockton sits beside Dingell during hearings and feeds him questions. He is believed by many scientists to harbor a personal antagonism toward the scientific com-

munity. Stockton says, however, that he merely acts on the initiative of his boss: Dingell is "the last of the kind to take on major interests, major corporations, and major agencies."

It is perhaps because Dingell appears to relish his role as giant killer that his style of congressional oversight has attracted so much criticism from scientists. He admits that he enjoys cornering witnesses as much as his other passion, wild-game hunting. "I always use the biggest rifle or the biggest shotgun I can take," he once told a reporter, "because when I shoot something, I want it to go down. I don't want any cripples running around."

Dingell is assailed incessantly by critics from both inside and outside science. They have called him "Emperor of Big Science" and "Torquemada" (the *Wall Street Journal*), as well as "thug," "pistol-whipper," and "Big Brother" (the *Boston Globe*). The two most frequent charges: that he is a publicity hound and a martinet who wants to control all that falls within his legislative grasp. Dingell's hometown newspaper, the *Detroit News*, compared the way he conducted the Baltimore hearings to the trial of Galileo. Martin Delaney, executive director of the AIDS activist group Project Inform, has called for an Iran-contra-style investigation of bias among Dingell and his staff, claiming that the "personal, political, and ego needs of the investigators" on Dingell's subcommittee unduly influence its choice of targets and its tactics.

Although the research community may feel victimized, it's difficult to argue that Dingell's zealous investigations stem from any bias against scientists. His investigative aim has been remarkably democratic, taking in chicanery at all levels of government, from the White House down. The subcommittee's probes into waste, fraud, and misconduct in science entail no more than several days of hearings each year.

And Dingell can hardly be blamed for playing the publicity game better than most of his colleagues. "He's the chairman of a congressional committee, he's an elected official, and naturally enough he likes publicity," says Joel Aberbach, director of UCLA's Center for American Politics and Public Policy. But, says Aberbach, "if the incidents that he's investigating have some substance in them, then it's hard to argue that he's abusing his authority."

Others have no quarrel with the substance of the hearings but fault Dingell for his persistence. "I think that he believes you get the mule's attention by striking it across the head with a two-by-four," says Milton Goldberg, executive director of a coalition of 135 research universities known as the Council on Governmental Relations. Goldberg complains that Dingell's "theatrical style" leads the press and public to overestimate the exent of mismanagement and malfeasance occurring in universities.

Science on the Defensive

The true extent of malfeasance in university science, while probably small, is impossible to measure. In any case, there may be less of it in the aftermath of Dingell's recent crusade to expose accounting trickery at the nation's top federally sponsored universities.

Dingell's hearings were triggered by a 1990 General Accounting Office investigation of several institutions, which disclosed that Stanford University had used the overhead, or indirect cost, allowance accompanying government research grants for such items as antique silverware, the depreciation on a yacht, and operating costs of a university-owned shopping center. Even before the investigation, Stanford had been known for aggressively exploiting loopholes in government contracts to help defray the costs of running the university.

This time, the subcommittee locked horns with Stanford president Donald Kennedy. Testifying last March, Kennedy insisted that many of the disputed charges, even if inappropriate, were "technically allowable" under the government's convoluted guidelines. Dingell called the Stanford case "a story of excess and arrogance, compounded by lax government oversight."

In the wake of the hearings, Kennedy announced he would resign. Several other institutions, hoping to avoid the kind of scrutiny that Stanford experienced, withdrew hundreds of thousands of dollars of their own charges to the government. MIT, for example, has so far repaid the government for almost $800,000 in mistaken and retroactively disallowed charges over a period of five years, including such items as flowers for the president's house, an official trip to Barbados, and legal expenses relating to the Baltimore affair.

As damaging as these revelations are, the research establishment's resistance to Dingell's investigations has probably done more to weaken the position of scientists than the investigations themselves ever could. In an incident of what Harvard biologist Edsall calls scientists "biting the hand that feeds them," Baltimore and close MIT colleague Phillip Sharp organized a "Dear Colleague" letter in 1989, appealing to scientists to write Dingell with their complaints about congressional intrusions on the profession's autonomy. The letters flooded in, but Dingell was not swayed. "They seemed to have some curious attitude that Congress should just give them money and say, here, fellas, have a good time," Dingell recounts.

David Guston, a staff member for the National Academy of Science's Panel on Scientific Responsibility and the Conduct of Research, calls the "Dear Colleague" letter an example of senseless brinksmanship. "You just don't do that kind of thing with members of Congress, yet alone the most aggressive and talented investigator on the Hill," Guston says. "A Nobel Prize

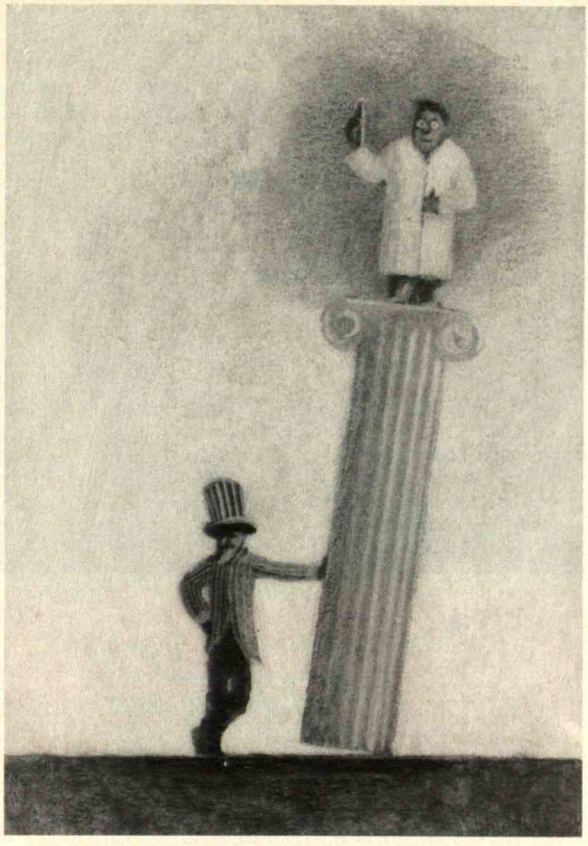
is not executive privilege."

Baltimore's defiant defense of Imanishi-Kari, in which he protested the very notion of Dingell's investigation, also stained his credibility. "Baltimore exemplified the position 'I'm a scientist, I can do no wrong,'" says Gilbert. "That's not a good version of science."

NIH director Healy, in a hearing last August, followed in Baltimore's footsteps. Dingell believed Healy was harassing members of NIH's Office of Scientific Integrity in an attempt to stall the investigation of Baltimore and of AIDS researcher Robert Gallo, who is suspected of manipulating data in two 1984 papers and of improperly using cell lines that led to his codiscovery of the AIDS virus. Incensed, Dingell called Healy in to answer questions about a 1990 misconduct investigation she allegedly botched while director of the Cleveland Clinic. Like Baltimore, Healy was righteous and combative in the witness chair, and sparks flew during the hearing.

Dingell insists that scientists have misinterpreted as unfriendly meddling his eagerness to see that taxpayers get what they pay for. Especially when it comes to the overhead issue, Dingell told *Technology Review*, "scientists should regard us as being a real friend." When the Office of Management and Budget proposed a punitive cap on one component of the overhead cost-recovery rate, Dingell and the rest of the Michigan congressional delegation wrote to the OMB director objecting that the cap could cause "undue hardship for a number of research universities."

Perhaps more to the point, efforts to limit overhead cost should not be interpreted as attacks on research. The smaller the proportion of each federal grant that goes toward administrative expenses, the more that actually goes to research. Scientists "would prefer to see the money coming in grants to them rather than going in large amounts to the universities," says Harvard's Gilbert. "Dingell is speaking strongly for the scientific community in looking at that."



Dingell's investigations could lead to an obsession with misconduct, undermining the mutual trust on which the scientific community is built, warns MIT biologist Robert Weinberg.

Still, some scientists scorn Dingell's efforts. Fraud and misconduct occur so rarely in research that the progress of science is not impeded, says MIT's Sharp, a cancer biologist. Dingell has blown the issue out of proportion, Sharp insists, and the subcommittee's revelations amplify public fears that university science has grown too powerful, too elite, and too distant from the real problems of society.

One root of scientists' concern about the subcommittee has been the notion that Dingell wants the government to police science. Dingell has repeatedly called this charge nonsense. His aim, he says, is "seeing to it that the scientific community has the tools, devices and mechanisms at hand to police itself, and to see to it that the results of government-sponsored scientific research are of a character that can be trusted. We'd like to see the scientists and the profession deal with that matter themselves.They have demonstrated a considerable and continuing lack of interest in doing that."

Is Science Being Slowed?

"The problem is with us," agrees Gilbert. "Until the profession and the universities show that they're policing themselves, the issue isn't going to go away." If scientists don't want a system of adjudication imposed from above, they must develop their own. Such a system, he says, "needs to satisfy the scientists as just, and it needs to satisfy the Congress that it's effective."

But many scientists and onlookers protest that the crush of attention Dingell has generated is choking the progress of research. "Dingell has created an enormous amount of insecurity and discomfort in academia," says MIT biologist Robert Weinberg, who laments that some scientists might respond with a "devotion to keeping records of the sort that have little scientific utility but

serve to ward off future data auditors." Such work diverts researchers' creative energies, he says.

The current obsession with scientific misconduct also undermines mutual trust and cooperation among scientists, Weinberg warns. If they cannot rely on the integrity of their colleagues in other specialties, scientists will be less likely to attempt ambitious, synergistic experiments such as those of Baltimore and Imanishi-Kari. Moreover, if the perceived rewards of belonging to an idealistic community based on mutual trust gradually vanish, the proportion of bright young students choosing science as a career could decline. Says Weinberg, "These negative effects far outweigh the marginal benefit gained by our heightened sensitization to the ethical problems of science."

Science's claim to a special position in society is being questioned as even the jewels in the research establishment are coming under legislative scrutiny.

AIDS activist Delaney largely agrees, maintaining that the investigations of AIDS researcher Gallo have tied up resources, diverted an enormous amount of the lead researchers' time, forced the repetition of experiments, and slowed collaboration with scientists overseas. "I don't see how that's benefiting anyone, and I can tell you for sure that it's harming people with AIDS," Delaney says.

But Dingell says he's puzzled when scientists complain that his probes are getting in the way of their work. "We have made very trivial demands" on the laboratories under investigation, he counters. If scientists are taking too much time away from their research to answer the subcommittee's questions, he says, "it seems to me that there's a line in the Bible that says the guilty flee where no man pursueth."

The forces straining the social contract that links science and government go beyond simple misunderstanding between Dingell and the scientific community. The members of Congress who created the postwar partnership, for example, have been largely replaced by a new generation of politicians. Committee staffs have grown larger and more expert, enabling Congress to scrutinize corners of science where it would not previously have dared to tread.

There is also the specter of the budget deficit. The days of the blank check are gone forever, and the current shortage of research grants contributes to scientists' siege mentality. "There's something about tight money that tends to de-iconize people," says UCLA's Aberbach. "It's harder to get up there now and say, 'I'm an atomic physicist, don't ask me questions.'" Ironically, although federal support for science continues to increase—spending for all categories of research and development will rise from $65 billion in 1991 to $72 billion in 1992—grants in many fields are scarcer because more scientists are competing for them.

But squabbling over the role of congressional oversight continues to be one of the largest obstacles to preserving the old partnership, say Gilbert and others. Perhaps worse, scientists' phobia of politics may intensify as a result of the recent uproar. "Scientists by and large feel that they are dirtying their hands if they deal with the political process," says Herb Lin, a former Congressional Science Fellow and committee staff member. "Something like the Baltimore affair makes scientists even more reluctant to get involved. That's exactly the wrong attitude to take."

The task of building a credible system for policing federally sponsored research will ultimately fall to scientists themselves. "There is a level of accountability that scientists may have forgotten in the last decade," says Dingell. "I would like to see scientists held to better standards than defense contractors." Scientists may have to reconcile themselves to closer supervision from Dingell and his successors as a permanent part of their work.

According to Gilbert, Dingell has provided scientists with an important reminder of something they have traditionally prided themselves on: the importance of asking tough questions. Scientists must view their own data, as well as the data of their colleagues, with more skepticism. They must be unafraid to point out lapses of professional conduct. And from time to time, they must be willing to reexamine their own place in the larger society. Says Gilbert, "Science is scientists saying, 'You challenge my work, I am responsible for it; I have to show you what's there.' We will come out of this better if we come out of it more skeptical." ■

AFTER THE USSR:

Environmental Management, Market-Style

By Steven J. Marcus

Out of a wrenching transition come visions of an industrial system that is both prosperous and ecologically sound.

A Westerner's impression of Moscow is one of bleakness, both in the gray aura of the place and in the demeanor of its people. Even St. Basil's Cathedral, that mad whirl of onion domes in Red Square so familiar as a backdrop for foreign TV correspondents, looks drab when viewed up close.

Russians are legendary for their pessimism—for "looking at the dark side of things"—though it's clear that their long history of strife and deprivation has given them much to be pessimistic about. And lately, despite the monumental political changes under way in the

ILLUSTRATIONS: TIM LORD

former USSR, relief is not yet in sight. Things were hard enough under seven decades of communism; but with the old system being dismantled and a new one not even defined, the economy is more strained than ever, and fears about the future abound.

Many people worry that widespread unrest, even revolt, could ensue if the fragile provisional economy fails to keep the population fed and warm this winter. Reawakened ethnic power could rekindle long-standing rivalries and hatreds, particularly amid today's economic hardship and displacement. And with the dissolution of the Soviet Union into independent republics, concern is mounting over revived nationalist movements, which contain extremist, neofascist elements.

But for all the legitimate fears of the region's citizens, a visitor can nevertheless detect a liberated energy—even, despite local remonstrances, a veiled optimism. Though struggling to overcome immediate problems, people seem keenly aware of new opportunities to shape their own future.

Nowhere are these opportunities greater than in environmental issues, which Russians refer to as "ecology" or simply "nature." Both the need to reduce pollution in the country's industrialized regions and the need to protect areas that are still untouched have gained recognition. In fact, my recent visit to Moscow (in early October) was occasioned by a conference on "The Social, Political, and Cultural Dimensions of the Environmental Crisis in the U.S. and USSR" (*see "The Conversation of Freedom," opposite*). While there, I met with government officials at both the "All-Union" and the republican levels, as well as environmental activists, a variety of researchers both scientific and humanistic, an entrepreneur, and several expert observers of life in the republics.

My purpose was not to document the region's environmental woes per se: numerous press and official accounts in recent years have already revealed both chronic problems such as severe air and water pollution in industrialized areas and one-time occurrences such as toxic spills and the Chernobyl accident. Both types of cases have inspired terms like "staggering" and "catastrophic."

The goal of my inquiries was to learn how those in power, and those with influence, propose to solve such problems. Understanding full well that action will likely be delayed in the coming months while the republics' citizens concentrate on simple survival, I was curious to hear about environmental leaders' long-term strategies and anticipated programs.

Continued on page 66

STEVEN J. MARCUS is the editor of Technology Review.

A Moscow symposium on the environment becomes a proving ground for liberated minds.

The Conversation of Freedom

WHEN Soviet and American scholars gathered in Moscow for a couple of days last October to discuss "The Social, Political, and Cultural Dimensions of the Environmental Crisis in the U.S. and USSR," many of the Americans spoke Russian, most of the Russians spoke some English, and translators did a reasonable job of filling in the gaps. Still, there was a failure to communicate—a great divide between theory and practice, between the general and the particular.

The conference was the second of six joint symposia under a project called "Science and Technology with a Human Face," sponsored by the MacArthur Foundation and led by Loren Graham, professor of science, technology, and society at MIT. The first, held in Cambridge, Mass., last May, concerned antiscience and antitechnology movements.

Although the conferences address real-world topics, no one expects hard-boiled strategies and programs to emerge from the mostly academic attendees. ("Is your conference people-to-people?" asked an American tourist at the U.S. delegates' hotel. "Well," said Leo Marx, a department colleague of Graham's at MIT, "let's just say it's egghead-to-egghead.") But even the U.S. scholars—largely historians and political scientists—were exasperated by the level of abstraction, disregard for continuity, and rugged individualism of the Soviet participants.

The conference papers themselves were mostly well written, informative, and stimulating, covering such topics as ethical trends in the Russian conservation movement, the portrayal of conservation in Soviet literature, and the politics of natural resources management in the United States. But the responses to the papers were mostly free-form. "I have several comments," a Russian respondent would typically begin. Twenty minutes later, after a seemingly stream-of-consciousness monologue, he would catch his breath and say, "My second comment is . . ."

Not that these "comments" didn't touch on some intriguing themes: the checkered history of conservation despite the traditional Russian "love of the land," the potential for nationalist movements to give rise to "eco-fascism," and a severe case of the Persian messenger syndrome (blaming the press for revealing serious environmental problems) that appears to be raging in local scholarly circles. But to U.S. attendees, the deliveries sounded like little more than potpourris, with superficial treatment of each subject and no apparent connective thread.

Why these rambling commentaries? Some Americans blamed the ornateness of the language (the Russian version of a paper tends to be noticeably longer than the English). Others speculated that the recent liberation of speech had produced a tendency to talk, talk, talk. But Loren Graham offered perhaps the best explanation: rebuilding a country demands intellectual latitude. "Because there is broad agreement in the United States on the structure of the society," he said, "Americans can be practical. But the USSR is a society in deep crisis—one that doesn't yet know what it wants to be—and resolution will require real ideas, not just committees."

In his provocative presentation on "Environmental Degradation and the Ambiguous Social Role of Science and Technology," Leo Marx seemed to underscore this point. He observed that analysis of pollution problems is too often limited to their biophysical symptoms, and he called upon humanists to play a role in probing, clarifying, and eventually correcting the "primary causes and consequences." He got what he asked for—but no one ever promised that the humanities would be a rose garden. At the best of times, exploration of philosophical, ethical, and religious ideas (all of which ensued) can appear open-ended and disorganized, especially to observers without a deep personal stake in the outcome.

To the humanistic dimension add the political—another messy but essential arena that demands great patience of its participants. In "Demythologizing Environmentalism," Douglas Weiner, assistant professor of history at the University of Arizona, argued that no single vision of human needs is ever appropriate, no matter how noble or well intentioned. In the real world, he pointed out, "we have to negotiate, democratically, in a political conversation." It was just such a conversation—freewheeling, uninhibited, and brave—that seemed to be unfolding on the conference-room floor.

Engaging in this conversation will be a new experience for former Soviets, and they will need to complement their prodigious scientific and intellectual resources with skills in the art of give-and-take. In the words of conference host Nikolai N. Vorontsov, USSR minister of natural resources management and environmental protection, "We have just come out of a long period of political 'monoculture,' which works in politics just as irrationally and inefficiently as it does in agriculture. Our task now is to develop the tools for political polyculture." ■

—Steven J. Marcus

Natural resources, which had zero value under the old system, must now be priced in a way that reflects their true worth.

Waiting for the Smoke to Clear

Nikolai N. Vorontsov, head of the now-defunct USSR Ministry of Natural Resources Management and Environmental Protection (*Goskompriroda*)—the rough equivalent of the U.S. Environmental Protection Agency and Department of the Interior combined (but with a far smaller staff and budget)—outlined his agenda in passionate generalities. He called for an all-encompassing "biospheric" thinking, as opposed to one-step-at-a-time technocratic thinking, so that the needs of nature and industrialized society can be addressed as an integrated whole. One must not eclipse the other, he said. A prominent biologist, Vorontsov spoke ardently of conserving native species and ecosystems; of expanding nature reserves, which now constitute 1.2 percent of the former USSR; of preserving the 45 percent of the region that is "virgin" by keeping it forever free of pollution; and of stemming pollutant emissions in the remaining 55 percent.

Vorontsov admitted that well-defined programs for achieving these goals were lacking. Such details would take time, he said: after all, his ministry was only three years old, and its regulatory authority would have to be legislatively defined before *Goskompriroda* could even begin to function like Western environmental agencies, much less achieve results.

But Vorontsov ultimately had neither time nor authority. Both have shifted to counterpart agencies in the newly empowered republics, which zealously claim the right to manage their own natural resources and industries. "*Goskompriroda* doesn't exist!" says Alexey V. Yablokov, a well-known environmentalist who serves as state councilor for ecology and public health in the Russian Republic. Though Vorontsov was highly regarded, he says, Soviets did not put much stock in a central ministry because many of the present environmental problems stem from the era of one-sided and unenlightened policies originating in Moscow. With those days over, says Yablokov, people throughout the region are determined to learn from history.

The staffs of the republican environmental ministries are highly motivated, well informed, and, in contrast to the United States, dominated by scientists. These agencies are young, but they see the future as theirs and are willing to wait for both funding and regulatory power. In the meantime, they concede a modest role for a central environmental ministry—"a small coordinating body," according to Yablokov—to minimize duplication in the republics' activities. For example, such an agency could help determine the health criteria underlying environmental standards.

Liya N. Shelest, deputy minister of the Russian Republic's Ministry of Ecology and Nature Use, believes that even such a coordinating function should be limited, given the existing array of bilateral and multilateral environmental agreements between the republics. Russia, she notes, has concluded pacts for jointly developing environmentally sound production technologies with Lithuania, Estonia, Kazakhstan, and the Ukraine, and other agreements are being negotiated. "With problems of ecology," says Shelest, "we can more easily come to the same conclusion than with problems of politics."

In the republics, as in Moscow, there is still a lot more talk than action. But an optimist could argue that while the agencies are awaiting real power, they are making

Russia's Ministry of Ecology and Nature Use intends to give industry incentives to adopt inherently clean processes.

sound intellectual preparation. Shelest talks forcefully about the need to "connect the economic with the ecologic, to equate avoidable waste with pollution." In that spirit, she says, pollution control must be "economically reasonable, even profitable," to be effective. Under the old system, natural resources essentially had zero value. Industry had no incentive to exploit them as efficiently (and therefore with as little polluting byproduct) as possible. "Often," says Shelest, "the value of industrial 'wastes' in the Soviet Union was higher than that of the material extracted." Thus environmental ministries must now work with other agencies—such as those responsible for energy, agriculture, and industrial development—to price resources in a way that reflects their true value. She believes that such a system will provide incentives to use materials thoroughly and wisely.

If this doesn't work, she says, her agency will invoke a second-stage system of incentives: penalties for polluting. Economists have long hailed such fines as an efficient pollution-control mechanism. But in practice—in the Soviet Union as in the West—penalties have amounted to little more than slaps on the wrist. Vorontsov describes the process as "taking money from one pocket and putting it in the other." Shelest rejoins that it's simple enough to raise the fines so they have their intended effect. In any case, she insists, the main goal is not to tax pollution after it has been produced but to prevent its emission in the first place. That's why she stresses giving industry incentives (such as correct pricing of natural resources) to adopt inherently clean processes and to use its byproducts.

Besides helping to set pricing and penalty regimes, the environmental ministries plan to provide environmental impact assessment—what the Russians call "expertise"—to determine the suitability of specific sites for industrial activity. One thing the ministries don't intend to do, though, is make the nitty-gritty decisions on how best to use resources to cut pollution. That task will fall to individual companies, whether state or privately owned.

Lessons from Real Life

Chances are that industries looking for ways to use materials efficiently will have no shortage of help from the private sector. Homegrown entrepreneurs are already looking to cultivate processes and develop products that solve environmental problems while turning a ruble. One such innovator is Rustam B. Akhmedov, former director of a government energy institute who now heads up Ecoenergetica, a company—or, as he calls it, a "state interbranch association of science and industry"—dedicated to developing "technology with both ecological and economic benefits." Akhmedov's strategy is to pursue short-term projects (reclaiming used automobile tires, for example, or extracting metals from incinerator ash) to subsidize longer-term technological developments (such as processes that capture the carbon dioxide in stack gases to slow global warming). He expects to find buyers for all salvaged materials. Akhmedov predicts that this sort of private-sector activity will grow as its profitability becomes apparent and will ultimately become the prime mover for the "rational use of natural resources" that environmental ministries hope to inspire.

The entrepreneur is confident for two reasons: the pricing of resources will help stimulate demand for his

Soviets agree that Western help in the form of technological know-how, personnel training, and economic advice would be invaluable.

innovations, and the vast Soviet experience with inefficiency and wastefulness has taught people what *not* to do. Thus, Akhmedov says, the form of his organization "comes from real life." Ecoenergetica's management structure, unlike that of the notoriously overstaffed Soviet institutes, is said to be lean and mean, with specialists carefully assigned to suitable departments and little administrative bureaucracy. As described by its founder, the company is closely akin to U.S. consulting firms—where most projects are self-supporting and based on individual contracts—and holds a similar allure for productive and motivated staffers.

Before long, says deputy minister Shelest, such innovations in workplace goals and procedures should help transform the industrial, and hence the environmental, character of the region. The changes will require massive improvements in worker training, assisted not only by Westerners but by "real life" mechanisms adapted from the military-industrial complex—the USSR's one smoothly running production system—where the best engineering talent was previously directed. "We can build the most modern submarines," says Shelest, "but our textile factories are nineteenth century."

Meanwhile, one might expect that environmental activists, having been a major force for bringing about democratic reforms, would be busy advising the environmental ministries and the aspiring entrepreneurs on ways to put their ecologically sound ideas into practice. But just as government administrators must defer action while the society addresses more pressing needs, environmentalists are entering a relatively quiet period. For one thing, they, like ministry analysts, are scientists who offer "expertise"—documenting that there is or isn't an environmental problem somewhere—not engineers who can implement solutions.

Another reason for the environmentalist slump is the weakened state of the economy. Energy-efficiency investments that might pay off handsomely within a few years hold little attraction for people who are worried about heating their homes right now.

What's more, the region's environmentalists, like their counterparts elsewhere, are burdened with a reputation for obstructionism. Most citizens want to move as quickly as possible to a market economy and are impatient with those who seem to stand in the way. "It is a difficult time for ecologists," says Natalia Yourina, deputy chair of an organization called Ecology and Peace. "We are seen as being against progress."

This image could improve as the ranks of leading groups such as Ecology and Peace, the Ecological Union, and the Social-Ecological Union expand and diversify. For example, Russian state councilor Yablokov hopes that more economists, many of whom he describes as having been "ecologically blind," will join the movement as it becomes clear that environmental goals engender economic opportunities. Indeed, if the policies of republican administrators such as Shelest prevail, the movement may come to be seen as a boon, not a hindrance, to prosperity.

A Transition to What?

Such prosperity may or may not derive from Western models of industry and trade. A nationwide debate is raging over the future of the republics' economies, with one extreme virtually worshipping the West and bent on duplicating its industrialization patterns, warts and all, and the other extreme distrusting anything foreign. In between, of course, is a range of more moderate attitudes. Most decision makers agree, however, that even if the republics rely entirely on native physical and financial resources, Western help in the form of technological know-how, personnel training, and economic advice would be invaluable.

"There's no way back," says entrepreneur Akhmedov. But at the same time, he notes, there's "no real infrastructure yet" for what the country is moving toward. Though Western advisers cannot dictate the transition's end point, they can at least help assure its progress and efficiency. With explicit and frank guidance, perhaps the country could even leapfrog the West in the pursuit of ecologically conscious industrialization. "We know your bright spots," says Yablokov, "but your scientists know the dark spots. By learning your mistakes, we will try not to repeat them."

Despite such promise, there is no guarantee of success—and perhaps no antidote to the Russian penchant for gloominess. "Look at the United States and Western Europe," says former USSR minister Vorontsov. "These countries have had long-functioning market economies and democratic systems, with many laws, penalties, and other economic regulations. Yet they still haven't achieved very much in protecting nature. As a result, for our country—which is just starting down this road—I am very pessimistic." ■

Sail On

THE time has come to celebrate the quincentenary of Columbus's first voyage to what we now call America, yet I hesitate to join in the festivities. My indecision is linked to the fierce revisionist crusade that is being directed against Columbus and everything he symbolizes.

The National Council of Churches has characterized the "discovery" as "an invasion and colonization with legalized occupation, genocide, economic exploitation, and a deep level of institutional racism and moral decadence." As writer Garry Wills sums up the mood of the contrarians, "If any historical figure can appropriately be loaded up with all the heresies of our time—Eurocentrism, phallocentrism, imperialism, elitism, and all-bad-things-generally-ism—Columbus is the man."

So far, this assault has not directly targeted technology. This being so, engineers might be tempted to keep a low profile. But how can engineers remain silent when they know that technology lies at the very heart of the Columbus adventure?

All the vices and bad impulses that critics associate with Columbus—as well as the heroic qualities his admirers hail—existed long before 1492. Conquest and exploitation did not begin with the Admiral of the Ocean Sea any more than valiant exploration did. What was new was the complex of technological developments that made it possible for sailors to venture out onto the open Atlantic with reasonable hope of finding a foreign shore and returning home safely.

A great achievement of the fifteenth century was the rapid evolution of sturdy, three-masted vessels that could make acceptable headway against the wind as well as with it. There were notable advances in the science of navigation as skilled artisans produced vastly improved maps, charts, compasses, and instruments for celestial observation. In various port cities, recordkeepers accumulated data about winds and ocean currents. A veritable center of ocean-sailing R&D flourished at Sagres in southwestern Portugal, sponsored by Prince Henry the Navigator. After Portuguese explorers rounded the Cape of Good Hope in 1488, the equipment and experience were in hand to justify Columbus's expedition.

Of course, technology alone cannot explain the European voyages of discovery. (The technologically advanced Chinese remained serenely content to let other peoples go exploring.) There were also geopolitical forces at work, such as the blocking of eastern trade routes by the growing Ottoman empire. Nevertheless, until science and technology reached their late-fifteenth-century stage of development, Columbus's venture would have been unthinkable.

In reflecting upon the meaning of 1492, I've been struck by how the yearning to explore and the impulse to do engineering appear to be related, not only in the practical world of cause and effect but also in the realm of the human spirit. Joaquin Miller's once-popular poem "Columbus" begins with an evocation of the explorer facing open and unknown expanses:

Behind him lay the gray Azores.
Behind the Gates of Hercules;
Before him not the ghost of shores,
Before him only shoreless seas.

How remarkably this verse resembles Robert Louis Stevenson's description, in *A Family of Engineers*, of his grandfather's musings on the engineering profession: "The seas into which his labours carried the new engineer were still scarce charted, the coast still dark." Although Miller's poem and Stevenson's florid prose sound naive today, I find the metaphor as valid—and as stirring—as ever.

Columbus's critics remind us that deplorable things have been done in the name of progress, and we can surely benefit from such admonitions. But we should also recognize that the natives who greeted Columbus 500 years ago were not residents of some mythical Garden of Eden. They had their own traditions of adventure, exploration, and technical ingenuity, being descended from peoples who journeyed across a land bridge from Asia.

Looking back over recorded history, and even into the mists of earlier millennia, we perceive at the heart of human nature a passion for discovery and invention. We can explain this passion as an evolutionary imperative—noting the survival value of creativity—or, more poetically, in terms of fate and destiny. We cannot, however, suppress or repudiate the essence of our humanity.

So I expect I will, after all, join with those who celebrate the impulse to explore the unknown. Engineers can profitably pay heed to critics who express reservations about progress. But in our heart of hearts, we echo the pulse-quickening refrain with which Joaquin Miller's Columbus answers his apprehensive crew: "Sail on, Sail on and on!" ■

SAMUEL C. FLORMAN, a civil engineer, is the author of Engineering and the Liberal Arts, The Existential Pleasures of Engineering, *and* The Civilized Engineer.

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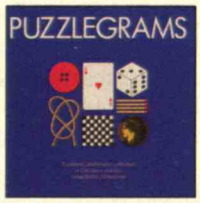

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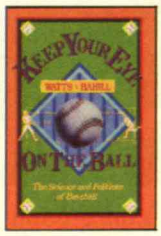

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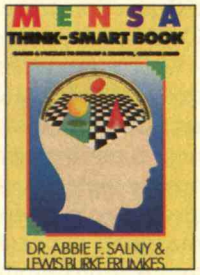

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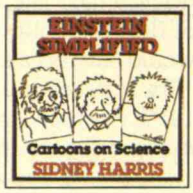

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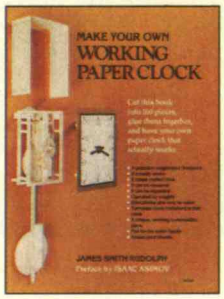

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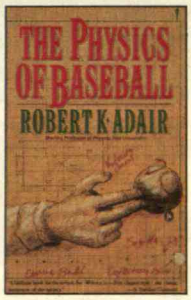

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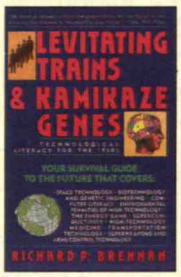

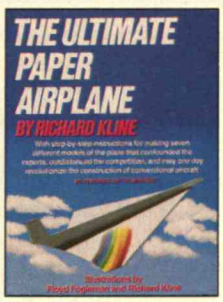

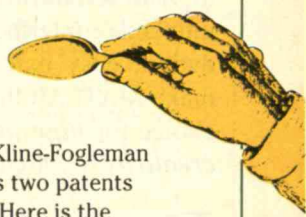

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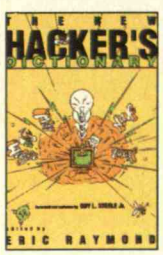

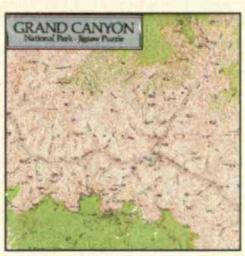

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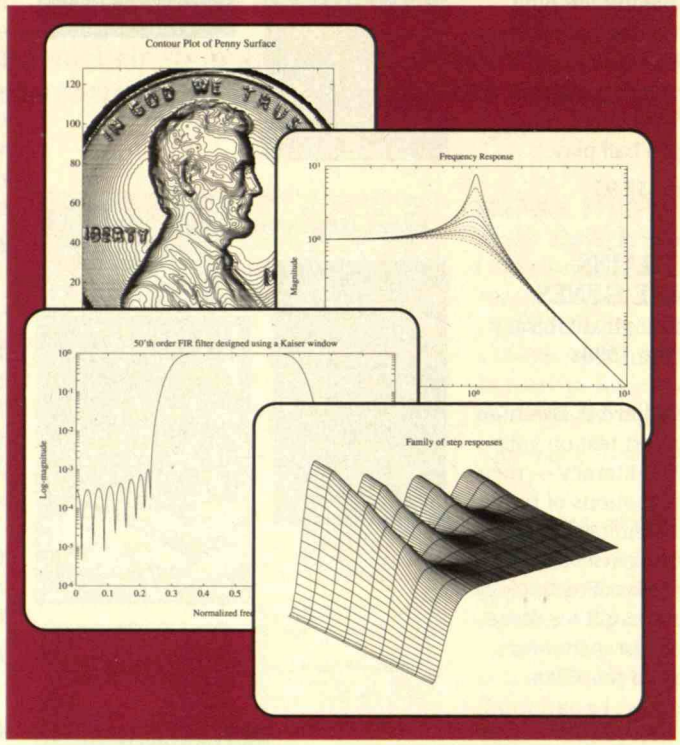

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The Gospel of Appropriate Technology

OLD news: throughout the industrialized world, large companies are far more likely to efficiently deploy computer-controlled factory automation than are small and medium-sized enterprises. That's why so many countries have launched generous government-funded industrial extension programs, designed to bring appropriate—which typically means off the shelf, rather than state of the art—technology to the attention of smaller companies.

New news: even as the White House officially pooh-poohs "industrial policy," at least one federal agency is bringing the gospel of appropriate technology to those parts of the private sector that have had the most difficulty in getting into the technological upgrading game.

That the small and medium-sized enterprises, or SMEs, have been such laggards bears seriously on this country's industrial competitiveness. SMEs make up the majority of suppliers and subcontractors to multinational corporations, as shown by a marvelous recent report from the Economic Policy Institute called "Modernizing Manufacturing." The SMEs don't install as many high-tech systems as their customers do. Nor are they as apt to introduce new methods of organizing the production process—such as statistical process control, just-in-time inventory, and design for manufacturability. Finally, this is the segment of U.S. industry that is either unwilling or unable to do much training.

To be sure, a number of federal and state programs have been launched over the last decade to promote R&D. The federal government has entered grand public-private partnerships such as Sematech, the Advanced Manufacturing Research Facility, and the National Center for Manufacturing Sciences. Pioneering technology-development efforts at the state level include Ohio's Thomas Edison Program and Pennsylvania's Ben Franklin Partnership. These programs are moving manufacturing technologies from the laboratory onto the shelf. But what about getting them off the shelf and onto the shop floor?

The lack of a federal mechanism to accomplish this end has probably been the greatest single shortcoming in U.S. industrial policy. True, some states have started programs expressly to diffuse appropriate technology to the SMEs, such as Georgia's industrial extension program, Maryland's Technology Extension Service, and Pennsylvania's Industrial Resource Centers. But these programs are underfunded and poorly coordinated. They are also politically vulnerable—Michigan's new Republican governor recently abolished the state's successful Modernization Service.

In 1988, Congress sought to begin to remedy the situation, redesignating the National Bureau of Standards as the National Institute of Standards and Technology. NIST has created five regional centers around the country to provide information about off-the-shelf manufacturing technology specifically to SMEs. The centers help firms evaluate their needs, and they encourage their clients to put more effort into training. Moreover, NIST's centers are trying to collaborate with—in some cases even subsidize—existing state programs.

But compared with the competition, the United States still has miles to go. Japan now has at least 169 regional centers to help transfer technologies to SMEs. While the centers are managed by prefecture governments, Tokyo establishes guidelines, provides some funding, and operates a national system for training and registering the consultants whose expertise the centers draw on.

Back in 1914, the U.S. government created the agricultural extension service—arguably the single most successful (and widely copied) example of government-business planning. Millions of small farmers learned how to use new tools, seeds, and pesticides to improve their yields and make a better living. The country established a network of research stations, land-grant university laboratories, and partnerships between private companies and local, county, state, and federal agencies.

Certainly, spreading the gospel of appropriate manufacturing technology poses a far more complex challenge than anything envisioned by those legions of "ag extension" agents. For one thing, small farmers tend to operate in splendid isolation, while competitive pressures in today's industrial markets are forcing manufacturers to work more closely with their principal customers and suppliers.

Still, the question seems fair: If industrial policy could work down on the farm, why not on the factory floor? Fortunately, a growing cadre of pragmatic and thoroughly unideological technologists and policymakers is already spreading the word and taking care of business. Let's hope they can pull it off—and that free-market zealots in the White House don't pull the rug out from under them. ■

BENNETT HARRISON is professor of political economy in the School of Urban and Public Affairs at Carnegie-Mellon University. He is co-author of The Deindustrialization of America *and* The Great U-Turn *(Basic Books).*

PHOTO OF BENNETT HARRISON BY L. BARRY HETHERINGTON

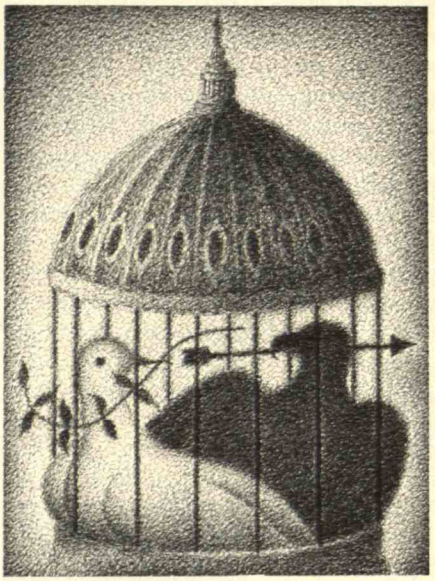
Reviews

BOOKS

OF HAWKS, DOVES, AND PORK BARRELS

Congress and Nuclear Weapons
by James M. Lindsay
Johns Hopkins University Press, $29.50

BY KATHERINE MAGRAW AND CHRISTOPHER PAINE



LATE last September, President Bush was widely hailed for launching a series of initiatives that radically defused the nuclear arms confrontation between the United States and the Soviet Union. Lost in the torrent of praise for the White House was the fact that within the preceding decade, nearly every aspect of the president's plan had been advocated or influenced by members or committees of Congress.

Some of the initiatives—such as phasing out ground- and sea-based tactical nuclear weapons and scrapping a rail-mobile deployment for the MX intercontinental ballistic missile—were the inevitable consequence of funding decisions previously taken by Congress over the objections of the executive branch. Far from being swept away by the White House announcement, Sen. Joseph Biden (D-Del.) dryly observed that it "conceded the obvious while defending the dubious," the latter being a jab at the president's continued support for the budget-busting B-2 bomber and Star Wars.

Conflicts over nuclear weapons policy have been a significant feature of congressional-executive relations since the first antiballistic missile debate from 1968 to 1972. In the last decade, Congress has been a hotbed of arms control proposals, ranging from a conditional moratorium on nuclear tests above a one-kiloton threshold to schemes for reducing the number of missiles with multiple warheads. Most of these proposals, though they attracted too little support to be adopted, influenced policy by compelling the bureaucracy to reexamine defense needs in light of changing world conditions. Other congressional decisions—on the MX missile, the Strategic Defense Initiative, and the Miniature Homing Vehicle Anti-Satellite Weapon—affected policy directly.

Nevertheless, Congress's contribution to shaping U.S. strategic policy often goes unrecognized. Even when it is acknowledged, commentators often belittle the legislative role by ascribing purely partisan or parochial motives to congressional behavior, as though these concerns were intrinsically less honorable than those that guide the executive branch.

James Lindsay, an assistant professor of political science at the University of Iowa, vigorously refutes this view of the congressional role in *Congress and Nuclear Weapons*. Lindsay argues that the best explanation for congressional decisions can be found in the personal policy preferences of individual members. He suggests that both parochialism and the tendency of the legislative branch to defer to the executive branch can sometimes be important but overall play only a subsidiary role.

Lindsay reaches this conclusion after testing which of three different "lenses"—the "policy lens," the "deferential lens," and the "parochial lens"—appears to offer the best fit for the data he has collected on the activities of the defense committees and the two chambers as a whole. Lindsay complains that notions of congressional involvement in nuclear weapons issues often have been based on anecdotes. He believes this methodology is "dangerous" in that it encourages selective perception. Because anecdotes most often document pork barreling, a theory based on parochial interests is the dominant view of congressional behavior.

Critical Factors

Yet it is also dangerous to suggest, as Lindsay does, that political analysis can be reduced to a choice between three nominally independent paradigms. Moreover, Lindsay's reliance on aggregated data leads him to ignore the details of political interaction that occasionally hold the key to explaining political outcomes. Anecdotes and case studies prove particularly useful when the subject of study is a complex, hierarchical institution with 535 independent players and a vast disparity in power between the leadership and the rank and file.

In September 1991, for example, the Senate swamped, 90–10, an effort by John McCain (R-Ark.) to stop production of the new Seawolf-class nuclear attack submarine, originally designed to hunt down and destroy Soviet ballistic missile submarines before they could launch their missiles. An observer who credited Lindsay's approach might conclude from this lopsided tally that most senators voted to preserve the Seawolf on policy grounds. But the story behind the numbers reveals that parochial and political factors—which Lindsay dis-

ILLUSTRATION: DAVE RIDLEY

counts—dominated the vote.

The relative newcomer McCain, usually one of the more hawkish Republicans, was trying to kill the Seawolf because he and most other senators recognize that this expensive Cold War program is no longer needed and is a drain on the budget. But McCain lost badly because the vast majority of liberal Democrats—including those who had previously opposed the Seawolf—stood by Sen. Christopher Dodd (D-Conn.), whose reelection prospects in 1992 would have been weakened if the General Dynamics Electric Boat division in Connecticut lost the Seawolf contract. The next time Congress votes on Seawolf, the yeas and nays could as easily be reversed.

What Lindsay fails to acknowledge is that his three factors—parochial interests, deference to executive-branch views, and congressional policy preferences—do not function independently. Each is highly sensitive to changes in the other two. Indeed, they are sensitive to other variables Lindsay does not even consider, such as political and personal alliances, tacit issue-based alliances between the legislative and executive branches, and broad shifts in public and media perceptions of what constitutes legitimate policy debate.

A Shifting Compromise

Lindsay also tends to ignore the connection between specific nuclear weapons "policy preferences" and the basic political outlooks of members of Congress. Quite apart from policy views, members' general ideological orientation (hawk or dove) is usually the best indicator of how they will vote on a given controversial weapons system. The Senate and the House typically divide into three groups: one that nearly always votes against nuclear weapons systems, one that nearly always votes for them, and a swing group that is up for grabs.

Even for those key legislators who set the range of options considered by Congress, policy preferences do not develop in a vacuum. Their positions are strongly influenced by the political and institutional environment—a fact that Lindsay fails to recognize. More often than not, the policy preferences of influential members represent a rationalization for a centrist compromise position. In the early 1980s, for example, a majority of members followed the lead of a few to authorize two new missiles in the name of arms control and strategic stability: the MX, a "destabilizing," silo-based missile with multiple warheads; and the Midgetman, a "stabilizing," mobile, single-warhead missile. This contradictory scheme (for which the Scowcroft Commission Report provided the policy explanation) was concocted by influential members and nuclear weapons experts in the center of the political spectrum to break the deadlock over the MX missile

Such an outcome is hardly the sum of individual evaluations of the policy merits of each weapons system. Rather, congressional decisions on nuclear weapons are the product of a constantly shifting political compromise, encompassing both key legislators and executive branch officials.

Since the varied and sometimes well-developed policy views of members of Congress often fall victim to compromise, it is no wonder that many analysts have failed to identify a clear congressional role in shaping nuclear weapons policy. But as suggested by the numerous congressional antecedents to Bush's September disarmament initiatives, even failed congressional proposals, or those muted by compromise, can have a lasting effect on U.S. policy. ■

KATHERINE MAGRAW is an American Association for the Advancement of Science Fellow on the staff of Sen. Paul Wellstone (D-Minn.) and a doctoral candidate in politicial science at MIT. CHRISTOPHER PAINE is a senior research associate with the Natural Resources Defense Council in Washington, D.C., and a former legislative assistant on nuclear arms control issues to Sen. Edward M. Kennedy (D-Mass.).

BOOKS

CONEY ISLANDS OF THE MIND

The American Amusement Park Industry: A History of Technology and Thrills
by Judith A. Adams
MacMillan/Twayne, $27.95

BY MICHAEL L. SMITH

ROBERT Benchley once observed that there are two kinds of people in the world: those who divide the world into two types of people and those who do not. Still, I'm tempted to suggest that two types of people go to amusement parks: those who want to have fun and those who want to write books.

Judith A. Adams, director of the Lockwood Library at the University of Buffalo, appears to be both types. The preface to *The American Amusement Park Industry: A History of Technology and Thrills* announces the book's intention to explore the points at which technology, amusement, and culture intersect. At the back of the book, a faded but charming photograph captures the author as a tyke, "enjoying the Keansburg, New Jersey, kiddie rides." The intervening 200 pages focus on the evolution of amusement parks from medieval fairs to the present. From my decidedly biased vantage point as a cultural historian, I welcome Adams's vivid accounts of amusements and contraptions, but I wish that a consistent interpretive perspective could have come along for the ride.

Role Reversal

In medieval Europe, where Adams begins, carnivals and fairs provided a temporary release from the oppression

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of everyday life by permitting a reversal of social roles. The prevailing image (and an actual attraction) was that of a peasant riding on a priest's back. Functioning as preindustrial social "safety valves," these sanctioned inversions of class structure served to perpetuate the status quo.

The rise of amusement parks as we know them coincided with the emergence of mass culture. By 1897, when Steeplechase Park appeared at Coney Island, a very different society sought release—this time from the imposed hierarchies of the urban industrial workplace. And Coney Island provided it. But Adams never explores this connection between twelfth-century trade fairs and the age of the Ferris wheel. She might have pressed her readers to consider the ways in which industrializing America sought to recapture the earlier fair goers' sense of temporary exemption from the rigid social order of their daily lives.

One way the parks met this demand was through the leveling effect of the rides and the crowds. Here the reigning image might be bodies tumbling in George Tilyou's Human Roulette Wheel. Strangers of all classes (primarily young single men and women) were thrown fleetingly into intimate physical contact. Elsewhere, compressed-air blowholes launched skirts skyward, while halls of mirrors and slapstick-wielding clowns reduced everyone to mirthful indignities.

Coney Island also provided release through a playful send-up of the mechanization that held the masses in its sway. As John Kasson elegantly demonstrates in *Amusing the Millions,* Coney Island used the technologies of the city and the industrial workplace—engines, turbines, rail cars, electric lights—to mock the regulated movement and industrial discipline required to live in those cities and to work in the factories, mills, and mines.

Mockery of technology is hard to come by at today's capital-intensive theme parks. The Future World pavilions at Disney's EPCOT Center, with sponsors like GM and GE and Exxon,

ILLUSTRATION: DAVE RIDLEY

are extensions of the world Coney Island lampooned—sanctimonious advertisements for the present and future uses of the sponsor's technology. ("We have entered a wondrous new age," the voice of Walter Cronkite assures us during AT&T's Spaceship Earth ride: "the Age of Information.")

At EPCOT, visitors find not an escape from the social structures and assumptions of today's multinational corporate culture but an elaborate sanctification of them. Perhaps the representative image for EPCOT would be visitors at GM's World of Motion, strapped into their automated vehicles while their Personal Audio Listening Systems sing, "It's fun to be free." Mingling occurs here as well, though less freely; cost, location, and occasional Disney crowd-screening policies have reinforced the park's decidedly middle-class profile.

Amusement, Inc.

How did we get from Coney Island to Disney World? Adams neglects to tell the full story. She does note that the shift to a middle-class clientele was accompanied by (and in part caused by) a change in ownership and management of amusement parks. In place of individual entrepreneurs like Tilyou—creator of

Coney Island's Steeplechase Park—came corporate owners with higher admission prices and a more reverent attitude toward technology.

What Adams doesn't make clear is that the Coney Island–style park and EPCOT Center grew out of two separate traditions, both introduced at the 1893 Columbian Exposition in Chicago. As she acknowledges, the 1893 exposition was really two events. Along the Midway, visitors found the Ferris wheel, exotic dancers like Little Egypt, and dispossessed Sioux warriors. This served as the model for Coney Island and the countless amusement parks, seaside roller coasters, and roadside carnivals that emulated it. Meanwhile, the White City, the official face of the 1893 fair, wrapped neoclassical stucco façades around displays from manufacturers. In Adams's words, it "created a material Elysium within an enclosed site by means of city planning, architecture, and technology."

Adams might have gone on to note that the White City inspired a very different tradition that connected the Columbian Exposition to EPCOT Center: corporate display. Although this variety of presentation was perfected at the world's fairs of the 1930s, several large corporations sponsored their own traveling shows—such as GE's Parade of Progress—which toured the countryside like sanitized carnivals. Walt Disney's accomplishment was to combine the "thrills 'n' spills" of the early amusement parks with the middle-class technology boosterism of GE et al. Yet he did so not by placing them side by side, as the Columbian Exposition had done, but by transforming traditional amusement park rides into advertisements for his films and characters, or for the sponsors of the exhibits.

Through its indulgence in corporate display, EPCOT dispenses an ideology of progress and authority along with the overpriced soft drinks. In this respect, the park has more in common with Bible World or Jim and Tammy Bakker's former empire, Heritage, U.S.A., than with Chicago's Riverside Park or with Cedar Point in Sandusky, Ohio.

I applaud Adams's effort to find cultural meaning in playland. And while I wish her interpretive voice had not been drowned out by calliopes and Ferris wheels, I recognize the hazards involved. During a recent visit to Disney World, I struck up a conversation with a family about our impressions of the park. When I mentioned that I was going to write about EPCOT Center, they were enthusiastic. But after I had talked for a couple of minutes about the park's depictions of technology, the 11-year-old exclaimed, "Who are you—the 'Grinch Who Stole Christmas'?" It's a tough job, but somebody's got to do it.■

MICHAEL L. SMITH, associate professor of history at the University of California, Davis, is the author of Pacific Visions: California Scientists and the Environment, 1850–1915 *(Yale University Press, 1988). He is writing a book about representations of technology in Cold War America.*

Reinforced concrete allowed Swiss engineer Maillart to avoid the heaviness of traditional bridge design. The wasp-waisted columns of his Arve River Bridge (1935) exemplify his approach.

BOOKS

BRIDGING BEAUTY AND ENGINEERING

Robert Maillart and the Art of Reinforced Concrete
by David P. Billington
Architectural History Foundation and MIT Press, $60

BY THOMAS FRICK

As a child in Michigan, I was infatuated with bridges. The Ambassador Bridge linking Detroit and Windsor, and the spectacular Mackinac Bridge spanning the five-mile gap between the state's upper and lower peninsulas, were dramatic structures that I crossed often. I owned a picture book with color plates depicting all the basic bridge types and their structural principles. My fascination stemmed in part from a presentiment that in bridges, aesthetics and utility were somehow closely allied. In the curve of an arch or suspension cable, one could read both beauty and the universal laws of force and strength.

Robert Maillart and the Art of Reinforced Concrete takes up where my early ruminations left off. It is a major monograph on the bridge designs of a pioneering Swiss structural engineer who lived from 1872 to 1940. The fruit of long and careful study, it also has an underlying philosophical mission. David P. Billington, a civil engineer at Princeton University, aims to show that the development of reinforced concrete construction opened up expressive opportunities that few engineers and architects besides Maillart have ever exploited. These new possibilities are not simply decorative doodads added to time-honored bridge or building designs. They result

PHOTO: ARCHITECTURAL HISTORY FOUNDATION

from contemplating the nature of the material.

The use of reinforced concrete for building was well established by 1900. François Hennebique in France and G.A. Wayss in Germany, among others, had already produced thousands of structures of all kinds demonstrating its economy, strength, and versatility. The material could replace wood, steel, or stone, and was more fire-resistant than all but the last. Yet these early pioneers were content to employ it in ways that visually followed the ancient traditions of stone and wood: thick arches, short-span slabs, massive structures.

Maillart, too, for several years after graduating from Zurich Polytechnical Institute, continued working in this manner. But shortly after founding his own firm in 1902, he began to explore concrete's immense formal potential. For him, this meant gradually but radically cutting away the visual and physical heaviness of traditional bridge design. In the Aare River Bridge of 1912, for instance, though he was still using heavy stone abutments on either shore, he removed the traditional bridge walls to reveal light columns running from the arch to the roadbed. This gave a graceful, airy appearance to what would otherwise have been a fairly squat, massive structure. By the time he built the Engstligen River Bridge, in 1931, Maillart had begun to cut into the solid form of the arch itself. In fact, this bridge is supported by two parallel thin, slightly skewed arches, allowing the roadway to cross the river at other than a right angle, while maintaining lightness of form.

The thinness and elegant curvature of many of his arches, deck spans, and supports—the sheer openness he achieved by eliminating unnecessary portions of walls, slabs, and buttresses—is startling and invigorating even today. Maillart's bridges are less intrusive and hence more landscape-sensitive than most of the ones we are accustomed to. With their simplicity comes a visual beauty that is almost like drawing.

Separate Entities

This integration of formal concerns with material and economic requirements Billington terms "structural art." He makes a case for Maillart's engineering work (and Maillart never saw himself as anything grander than an engineer) to be considered an important part of architectural history. In the past, when structural engineering, and especially bridge design, has been given such scholarly consideration, the aesthetic and structural dimensions have been dealt with as separate entities. The architectural component has generally been regarded as a decorative overlay having little to do with structural principles.

As Le Corbusier wrote in *Towards a New Architecture:* "The Engineer, inspired by the law of Economy and governed by mathematical calculation, puts us in accord with universal law. He achieves harmony. The Architect, by his arrangement of forms, realizes an order which is a pure creation of the spirit." Today, with the postmodern embrace of ornamentation and decoration, these two aspects of the builder's art are as dichotomous as ever. Yet in Maillart's work, everything is of a piece: the aesthetic approach is derived from structural necessities in a direct and uncomplicated way.

Robert Maillart and the Art of Reinforced Concrete, though not highly technical, allows the reader to grasp the structural basis of Maillart's design decisions. Its chronological organization and exquisite photography (most of his work was done in the Swiss countryside) give a clear sense of how Maillart's thinking evolved. In its patient way, it has taught me new ways of looking at the relationship between structure and form, and showed me how much was missing from my childhood musings.■

THOMAS FRICK, who lives in Los Angeles, writes for Art in America *and other magazines.*

R_X FOR TROUBLED PORTS

In studying whether they can benefit from Ernest G. Frankel's proposal for artificial offshore islands (*"The Call of the Islands," TR November/December 1991*), port cities should bear in mind that at least five groups compete for the land in the port itself.

First are the traditional facilities provided by port authorities, port commissioners, dock boards, and so on, all of whom recognize the economic impact that cargo moving through a port has on the overall community. They also understand that to be cost-effective they must use large tracts of land and have adequate land access. The second competing group is composed of traditional industries that require waterside facilities if they are to be both cost-effective and cost-competitive—e.g. oil terminals and grain elevators.

Third, real estate developers have turned their attention to port areas, and this, too, has its advantages, since it could stem the flight to the suburbs and provide the cities with a larger tax base. The fourth competing group is made up of recreationalists, who have been successful in turning unused or outmoded port facilities into parks and marinas, and fifth are environmentalists, who would like to return port land to its original status.

These five groups will eventually use all the land available onshore. Prof. Frankel's proposal offers a solution, at least to providing cost-competitive cargo facilities. He is to be commended for his foresight.

CAPT. WARREN G. LEBACK
Maritime Administrator
Department of Transportation

CORRECTION

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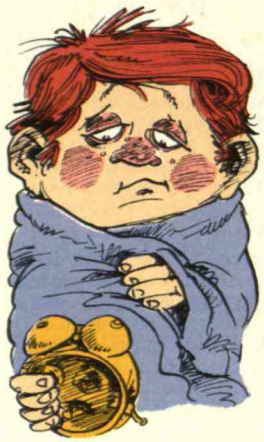

Cold Cure?

For a child with the common cold, prescription medicines, sugar pills, and doing nothing have virtually the same effect. Researchers at the Johns Hopkins Children's Center randomly assigned 96 children aged six months to five years to three groups. Some took a combination antihistamine-decongestant, some took placebos, and the rest took nothing. Children usually got well within 48 hours regardless of treatment, says team member Nancy Hutton.

Rainforest Threat

The world's largest expanse of uncut forests will face new threats as the Soviet Union invites foreign investment and joint ventures. To earn hard currency, the Soviet Union is opening Siberian forests to exploitation by Louisiana Pacific and other major Western logging firms, who are interested in offsetting declining harvests elsewhere.

"The boreal forests of the Soviet Union appear to be where the Amazon was 15 years ago," says Russell Mittermeier, president of Conservation International. "If we have learned anything from our experience in tropical rainforests, it is that large, pristine areas can be jeopardized very quickly when national authorities decide their resources should be exploited."

Stretching from the Urals to the Pacific Ocean, the forests cover an area roughly two-thirds the size of the continental United States. But the vast forests are fragile because trees regenerate slowly in the Arctic climate.

Touchless Testing

Circuit boards are now tested by touching contact points with metal pins. Not only can such tests damage a tiny circuit, but they also become more difficult as the features on boards shrink and devices and circuitry are embedded in layers.

Now Rensselaer University researchers Don Millard and Robert Block have devised a way to test printed circuits without touching the boards. Instead of metal pins, the new method uses a laser beam to create a narrow stream of highly conductive plasma. The plasma can be carefully directed to test the circuits without damaging them.

Fireproofing Japan

The National Institute of Standards and Technology is participating in a Japanese study of how multi-family wood-frame houses withstand a fire after an earthquake. As part of a new trade agreement, Japan will change its building codes to allow the construction of more wood buildings, opening a market for U.S. firms.

With funding from the U.S. National Forest Products Association, NIST fire and earthquake experts will assist Japanese researchers in full-scale tests on a three-story wood building. A NIST computer model will predict the spread of a fire and probable heat and smoke hazards.

Analyzing THC

University of Connecticut scientists have taken a step toward understanding the workings of THC, the active ingredient in marijuana and hashish. A synthetic compound developed by graduate student Avgui Charalambous carries a radioactive tag that helps trace THC's path through the brain.

Exactly how THC interacts with the brain—especially how it affects the protective membrane of cells—is unknown, but this new synthetic molecule could contribute to therapeutic uses of cannabis. The tracer has already revealed evidence of a receptor protein in the brain that THC attaches itself to and triggers a series of chemical reactions.

Glastic or Plass?

Chemists at the University of California at Berkeley have found a way to create plastics with the properties of glass but only one-fourth the weight. Chemist Bruce Novak and his colleagues have blended more than 20 different organic polymers with glass; theoretically almost any organic polymer like polypropylene or polystyrene could be incorporated into the composite.

Unlike similar technologies

that have been around for a century, the technique produces plastics that don't shrink as they cure, so they can be molded into any shape. The new process lets the polymer and glass form at the same time, so a polymer chain is woven into a glass matrix. "What you get is an interpenetrating network of organic and inorganic phases, blending the two near the molecular level," Novak says.

Readable Text

What you get out of a book has a lot to do with how the words look on the page, says University of Rochester linguist Thomas Bever. A computer program he and his colleagues have written makes text more readable by placing extra space at the ends of phrases and by avoiding awkwardly breaking ideas between lines. When Bever tested the program in an introductory science class at a local community college, those reading reformatted books got nearly twice as many A's and B's as a control group did.

Bever views his work as the next step in making writing accessible. "In the first written records, there were no spaces, even between words. After spaces came sentence punctuation." So, he says, "using a computer to insert extra space around phrases is just taking this process into the twentieth century. This is like a twentieth-century comma."

ILLUSTRATIONS: JON McINTOSH

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